ELECTRICAL REVIEW

Vol. CXLIX 14th DECEMBER, 1951 No. 3864

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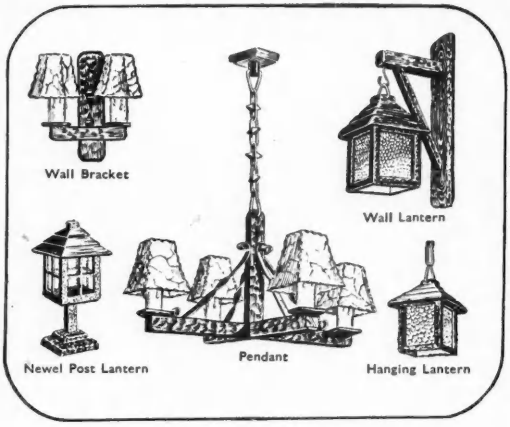

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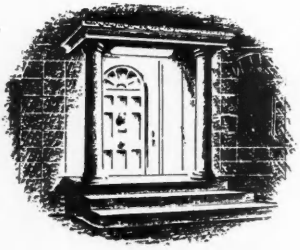

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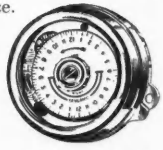

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ELECTRICAL REVIEW

Vol. CXLIX No. 3864 14TH DECEMBER, 1951

THE OLDEST ELECTRICAL PAPER ● ESTABLISHED 1872

Post-Graduate Education

SUGGESTIONS FOR MEETING A PRESSING NEED

THIS country has always been foremost in scientific and technological developments, particularly in the electrical and allied fields, but it can only maintain this position if suitably trained men are available in sufficient numbers. To ensure this it is essential that adequate facilities for technical education at both the undergraduate and post-graduate levels to suit the needs of industry shall be available.

Modification Necessary

This subject is now being raised with increasing frequency and discussions appear to show that a certain amount of reorganization or modification of the existing system of technical education is necessary. In spite of the shortage of both accommodation and teaching staff in the colleges and universities generally much has been done towards meeting the demands of industry. On the whole the existing undergraduate and National Certificate courses are satisfactory, although if the suggested Royal College of Technologists comes into being it may be desirable to raise the standard of both the Ordinary and Higher National Certificates.

As knowledge is now advancing with great rapidity it would appear necessary to raise the standard of all courses but unfortunately the ability of students to absorb new ideas and information does not grow at a corresponding rate with the increase in ideas. The solution is to provide more post-graduate courses and it is surprising how little has been done in this direction.

Among other things, Dr. H. L. Haslegrave devotes his attention to this matter in a paper on technical colleges and education for the electrical industry which is reported elsewhere in this issue. Dr. Haslegrave points out that industry vitally requires such courses and he goes on to assert that the technical institutions are particularly suited for their organization because of their close association with industry and their reservoir of experience.

Nature of Courses

Post-graduate courses fall broadly into three groups, the first dealing with highly specialized subjects, the second enabling engineers to refresh their knowledge of those subjects with which they have not been concerned for some time, and the third involving an extended study of a particular branch of engineering. To afford the maximum benefit these courses should be closely inter-related to research and

there should be co-ordination between research and post-graduate study.

Although refresher courses may not be regarded as truly " post-graduate " they would serve a most useful purpose if they could cover certain well-defined aspects of electrical engineering in which an expert presents recently-published knowledge in a palatable form and without resort to higher mathematics. The need for this type of course has grown during recent years as it has become increasingly difficult for one man to keep abreast of more than one part of his own field.

Higher mathematics, however, should most certainly not be excluded from, or minimized in, the other courses. In fact, as much time as is economically possible should be spent in imparting to students a thorough working knowledge of the most valuable tools offered by mathematics, for without them many subjects, such as the study of electromagnetic waves, servomechanisms and network analysis, cannot be properly grasped.

WIRING ALTERNATIVES

Electrical contractors and electricians brought up on steel conduit are prone to refuse all substitutes. The use of new forms of conduit involves new techniques if satisfactory installations are to result and it may be hard to get operatives to learn them. Yet the shortage of steel conduit, which is likely to prevail for some time, will force contractors to adopt other forms of wiring protection. In present circumstances copper tubing is unlikely to be more available than steel and it is much more expensive. Aluminium is probably more easily obtained, either as solid or flexible tubing. Insulated conduit has not yet been widely used but is of a more plentiful material; on earthed installations, however, it necessitates a separate earth conductor. Surface wiring systems, including the mineral-insulated type, are, of course, a satisfactory (and perhaps the only) alternative to conduit in many cases.

STEEL CONDUIT SUPPLIES

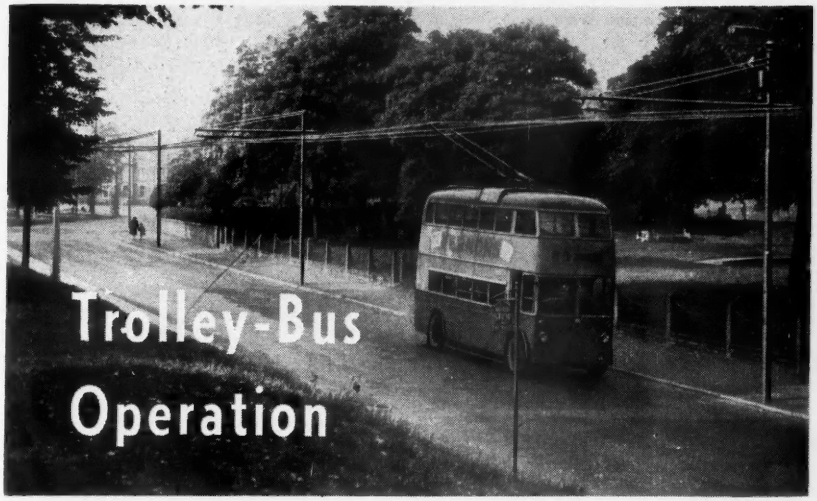
In a further notification regarding the allocation of steel, Mr. L. C. Penwill (director and secretary) has told members of the Electrical Contractors' Association that the E.C.A. has asked the appropriate Government Departments to investigate certain matters. The Association wishes to be satisfied that conduit is being used for the purposes for which it has been manufactured. It asks that inquiry shall be made into the quantity of materials reaching producers of conduit and the distribution of conduit after manufacture. It also desires to know what the prospects are of there being sufficient conduit available to meet authorizations issued under the allocation scheme which is to come into force in February. The Association is not prepared to issue " paper " which does not assist members in obtaining the conduit authorized.

DIESEL MAINTENANCE

Considering the diverse conditions, including running hours, under which heavy-oil engines are operated, the Diesel Engine Users' Association has been remarkably successful in co-ordinating returns from numerous sources on a recognizable basis. The latest report of the Association, reviewed in this issue, reveals no predominating cause of mechanical failures, which are nowadays due in the main to wear and tear rather than to initial combustion pressures. Repairs and maintenance form an appreciably smaller proportion of the total running costs than they did before the war. Engines of the mechanical-injection type, although less thermally efficient as an average, incurred lower maintenance and total operating costs than others.

AMERICAN APPLIANCE PRODUCTION

In view of the domestic appliance situation here it is of interest to read in *Electrical Merchandising* that the output of domestic electrical appliances and radio and television apparatus in the United States may fall to half the 1950 rate by the spring. Short of a major war, however, it is considered unlikely that it will go any lower, at any rate on account of shortages of raw materials. Under the Controlled Materials Plan appliance manufacturers will receive allocations for as much steel, copper and aluminium as can be spared after urgent defence demands are met and it is hoped that these will be sufficient to enable production to be maintained at about 65 per cent of the rate before the outbreak of the Korean war. Copper and aluminium shortages are likely to prove the principal handicap in the production of electrical appliances.

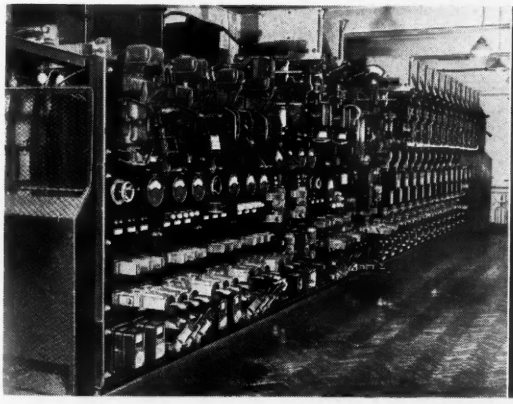


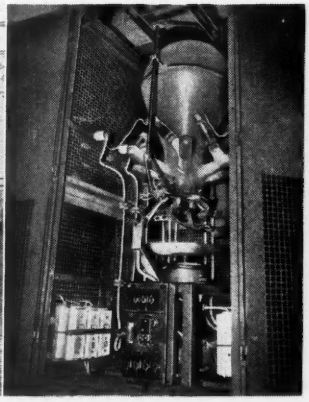
Trolley-Bus Operation

Supply Arrangements at Wolverhampton and Walsall

ALTHOUGH in some quarters trolley-buses are undergoing a period of disfavour, nothing has occurred of late to detract from the advantages of this form of transport for certain conditions. In busy, highly populated areas in particular, their rapid acceleration between closely spaced stopping points, together with their freedom from noise and fumes, gives them a strong claim for superiority over other forms of transport. The present situation regarding the balance of overseas payments as well as recent developments in Persia also raise the question whether it is advisable for the country to depend on imported fuel for its road transport.

Above: **One of the latest Wolverhampton trolley-buses.** *Below left:* **The main traction switchboard at Commercial Road, Wolverhampton.** *Right:* **One of the 200 kW mercury arc rectifier bulbs at Wells Road substation, Wolverhampton**



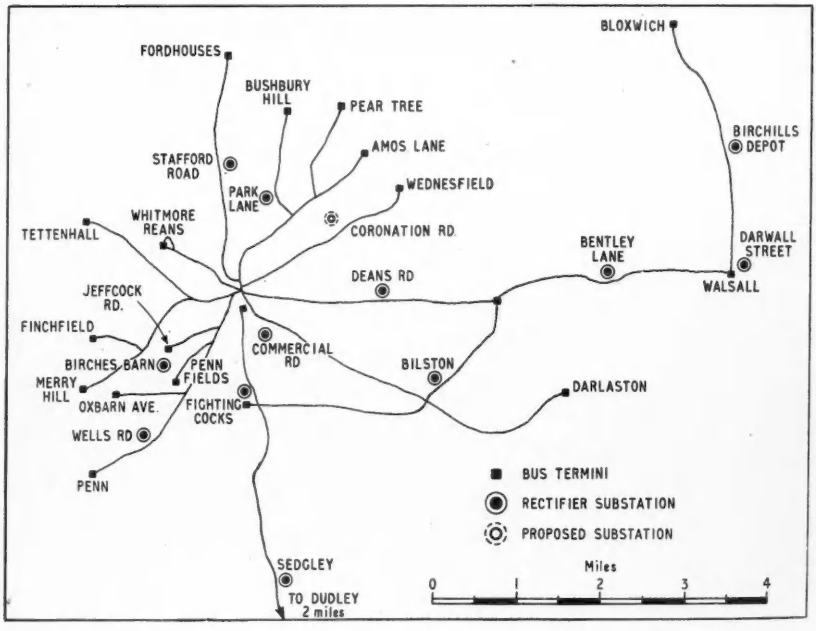


There are, of course, numerous transport undertakings both in this country and abroad in which trolley-buses are proving their worth, not only from the point of view of convenience and comfort, but also because of their efficiency and economy. Those which we were given the opportunity of inspecting recently at Wolverhampton (general manager: Mr. R. H. Addlesee; engineer and deputy general manager: Mr. E. G. A. Singleton) and Walsall (general manager and engineer: Mr. M. J. Somerfield) confirm this.

At Wolverhampton trolley-buses have been in use since 1923 when a commencement was made in changing over the transport system from trams. The last tramway route was converted in 1928 and since then the fleet of trolley-buses has been steadily augmented to run over 48 miles of route until to-day it numbers 172. In the year ended 31st March last, these travelled 5,925,298 miles and carried 79,430,015 passengers, bringing in a revenue of £616,943. Working expenditure totalled £499,793, giving a surplus of £117,150. For comparison (which must not be taken too strictly in view of the difference in duties performed) the Corporation's 126 motor-buses operating over 245 miles of route travelled 4,139,496 miles, carried 33,232,295 passengers, produced a revenue of £355,519, cost £336,444 to operate and showed a surplus of £19,075. Loan charges and other capital expenses, however, absorbed all the working surpluses and the net result was an overall deficiency of £68.

Similar statistics for the Walsall trolley-bus undertaking, which dates from 1931, show that for a mileage of 869,078 and the carrying of 13,607,854 passengers the 34 trolley-buses operating over 9 miles of route produced a revenue of £99,794 at a working expenditure of £86,113, there being a net credit balance of £7,859. On the other hand, the 208 motor-buses, costing £579,236 to run, brought in only £576,290 from the 67,155,916 passengers carried for a mileage of 6,574,611 over

Map showing the extent of the Wolverhampton and Walsall trolley-bus systems and indicating the positions of the rectifier substations



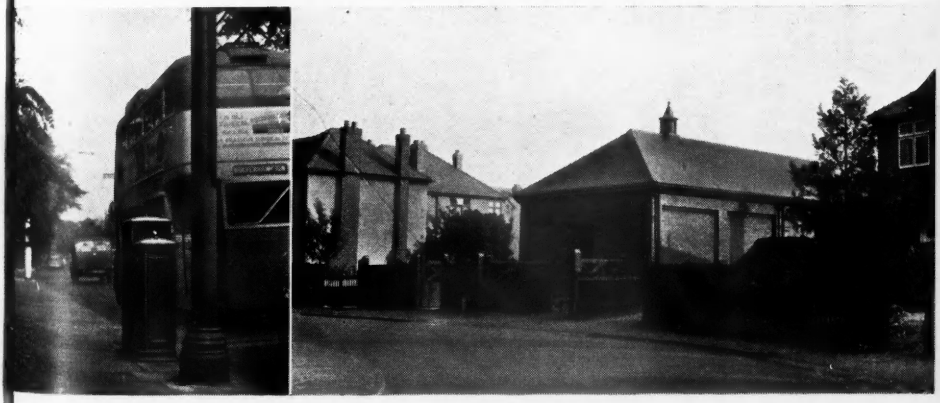
Some of the 56-seater trolley-buses acquired by Walsall Corporation this year

348 miles of route, there being a net deficit of £55,318.

Through-running agreements have been made between the Wolverhampton and Walsall Corporations for the route between the two towns. The electrical systems supplying the two undertakings, though both are now operated by the Wolverhampton & District Sub-Area of the Midlands Electricity Board (Sub-Area manager: Mr. F. J. Elliott), have been kept separate, the transition from one to the other being made at Willenhall. In general, however, the supply arrangements are very similar and have developed on similar lines.

The first trolley-buses used in Wolverhampton were single deckers of Tilling Stevens manufacture, utilizing series-parallel control with the two motors built in one carcase, both armatures on a common shaft. Guy vehicles utilizing the Rees-Stevens regeneration system were put into service in 1926, and this type of vehicle was purchased up to 1942. The difficulty of dealing with regenerative current in

Left: **Typical section pillar with an automatic sectionalizing switch in pillar adjacent.** *Right:* **The automatic unattended rectifier substations are designed to harmonize with their surroundings. This one is in a residential district in Wells Road, Wolverhampton**



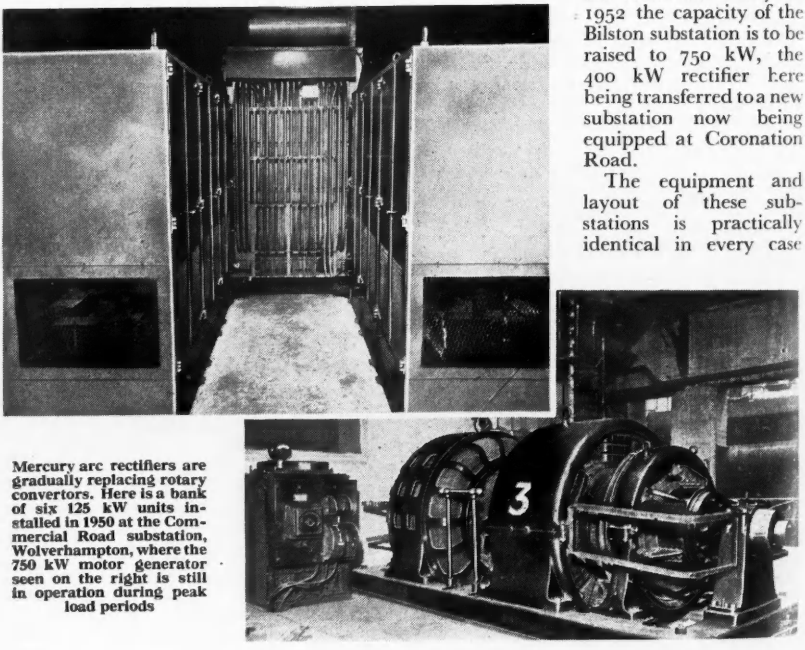
non-receptive lines brought about by the extensive use of mercury arc rectification eventually resulted in a change-over to series motors with slight compounding to provide rheostatic braking. Similar experiences were encountered with the same outcome at Walsall where a fleet of twenty-seven Sunbeam-B.T.H. vehicles has been recently supplemented by ten of the latest type of Guy-B.T.H. vehicle.

Originally the 550 V direct current supplies required to operate the trolley-buses came entirely from motor and rotary convertor sets installed in the substations at Commercial Road, Wolverhampton, and Darwall Street, Walsall. With the extension of the system and the use of additional heavily loaded vehicles, voltage drop at the outer portions of the routes made it necessary to provide a series of booster stations at various points connected to the 6,600 V network.

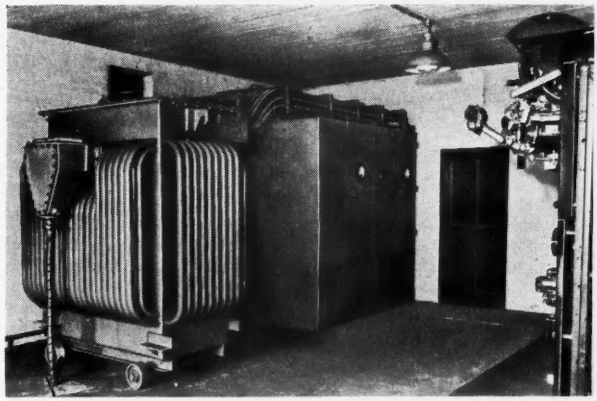
During the past ten years eight of these booster stations, which take the form of unattended mercury arc rectifier sub-stations, have already been provided at Wolverhampton, with a ninth due for completion early next year. Walsall also now has two of these substations. The situations of the substations in relation to the trolley-bus routes are shown in the accompanying map.

The first rectifier substation at Wolverhampton was put into commission in 1932 at Birches Barn. This, like the one completed the next year at Park Lane, has a capacity of 500 kW. Five more substations, each with a capacity of 400 kW, followed at the Fighting Cocks (1935), Bilston (1937), Wells Road (1937), Stafford Road (1940) and Deans Road (1945). In 1947 a 500 kW unit was erected at Sedgley and last year two 750 kW Hewittic rectifiers, each comprising six 125 kW banks, were installed together with two Hackbridge & Hewittic 750 kW transformers, at the original substation at Commercial Road to replace a 1,250 kW rotary convertor and 750 kW rotary convertor. The two sets remaining (an English Electric Co. 1,250 kW rotary convertor and Bruce Peebles 750 kW motor generator) are now only used during peak load periods and will also be superseded eventually by mercury arc rectifiers. Early in 1952 the capacity of the Bilston substation is to be raised to 750 kW, the 400 kW rectifier here being transferred to a new substation now being equipped at Coronation Road.

The equipment and layout of these sub-stations is practically identical in every case



Mercury arc rectifiers are gradually replacing rotary convertors. Here is a bank of six 125 kW units installed in 1950 at the Commercial Road substation, Wolverhampton, where the 750 kW motor generator seen on the right is still in operation during peak load periods



irchills substation, Wal-ll, showing 500 kVA ansformer, two 250 kW eel tank rectifiers and corner of the d.c. board ith high speed circuit breakers

nd that at Wells oad may be taken typical. Here the 600 V feeders are ken to a Reyrolle ush-button motor erated oil circuit eaker of 150 MVA pturing capacity. oth kWh and maxi-um demand meters are provided and here is a Venner time switch for cutting off the supply at night when the trolley-buses are not running.

A 6,600/550 V 400 kVA Hackbridge transformer feeds two 200 kW Hewittic glass bulb mercury arc rectifiers which are fitted with ammeters. The direct current is fed out to the section pillars, located about every half-mile along the trolley-bus routes, through Whipp & Bourne high speed circuit breakers which are provided with auto-reclosing gear set to operate up to three times before locking out. Veeder counters showing the number of times of operation are installed. Regeneration is taken care of by a loading resistance operated through voltage and current relays and the no-load voltage of the rectifier is also controlled by means of a light loading resistance operated through relays. Automatic section switches between two adjacent substations ensure that in the event of failure of either the fault is confined to one section only.

Walsall Booster Stations

The two booster stations at Walsall, Bloxwich (completed in 1943) and Birchills Depot (1950), are practically identical as regards equipment and layout. Alternative 6·6 kV supplies are provided, the 0·1 sq in feeders being taken to Ferguson Pailin switches of 150 MVA rupturing capacity arranged for spring closure. The 6,600/550 V 500 kVA transformer and the two 250 kW steel tank mercury arc rectifiers are all of English Electric construction. Solenoid closure is provided on the switches covering the supplies to the rectifiers. Whipp & Bourne high speed circuit breakers (1,500 A) are again used for the d.c. side. A regeneration panel is still in use.

G.E.C. equipment operated at 50 V by Chloride batteries provides for supervisory control from the main substation at Darwall Street. Here can still be seen two 500 kW rotary convertors (Siemens and B.T.H.) which, served by 525 kVA Brush transformers, have been in continuous service since 1914 and 1920 respectively. A small 70 kW Hewittic glass bulb rectifier was installed in 1936 to save operating the rotary convertor during the night.

Every trolley-bus incorporates a motor of 70–90 h.p., and the amount of electricity required to operate the 172 vehicles in use at Wolverhampton amounted last year to 15,393,340 kWh; the aggregate maximum demand recorded on the various substations was 4,770 kW. The thirty-three Walsall trolley-buses consumed 2,254,069 kWh and created a maximum demand of 811 kVA.

As to the prospects of further extension of the systems the cost of providing overhead equipment is extremely high. On the other hand, the greatly increased cost of motor fuel gives trolley-buses an advantage with regard to power cost. Trolley-buses in themselves require on the average less maintenance, but this advantage is absorbed when the cost of maintenance of overhead line and power cables is taken into account. Modern vehicles of both types have approximately the same economic life, which under present conditions can be expected to be from fourteen to fifteen years.

Light-Sensitive Cells

Differentiation Between Photo-Electric Types

By R. H. WARRING

THERE are three distinct types of photo-electric cells, each with its own separate characteristics. The oldest is the photo-conductive, or selenium, "bridge," the resistance of which varies appreciably with the amount of light illuminating it. This type of cell is made part of an electrical circuit and the measured change in resistance is an indication of the variation in, or the amount of, light striking the cell.

In direct contrast is the rectifier, or photo-voltaic, cell, which does not require any external source of potential. Light falling on the cell is converted into electrical energy and, if the cell is coupled to a suitable external circuit, current will flow in that circuit when the cell is illuminated.

The third basic type is the photo-emissive cell, to which the name photo-electric cell most truly applies. Correctly when speaking of a photo-electric cell one should mean the emission type cell.

The resistance bridge in its simplest form consists of a layer of selenium metal in crystalline form arranged on an appropriate backing and connected in series with a suitable electric circuit (Fig. 1). The bridge itself will be of comparatively high resistance and a fixed potential of something like 100 V may be used. The change in resistance characteristics of the bridge under different degrees of illumination (Fig. 2) indicates that at greater light values the bridge becomes "saturated," rate of change in this region being small. In other words, the bridge is not particularly sensitive to strong illumination, but markedly sensitive to illumination at the lower end of the scale. In consequence, this type of selenium cell is particularly applicable to the measurement of the lesser light intensities.

The modern bridge consists of a layer of pure selenium about 0·01in thick laid on a grid of inert metal that is bonded to a ground glass plate (Fig. 3), the whole being enclosed in a glass envelope which is evacuated, or filled with argon or a similar inert gas at a pressure somewhat below one atmosphere. The cell will not be stable until it has been "aged," which can be promoted artificially by exposure of the cell alternately to light and darkness with the normal potential applied to the electrodes.

The photo-voltaic, or rectifier, cell again uses selenium, but operates on an entirely different principle. A thin layer of selenium is formed on a steel plate and covered with a very thin film of an inert metal, so thin that it is transparent. Contacts are taken from this top layer of noble metal* and the steel

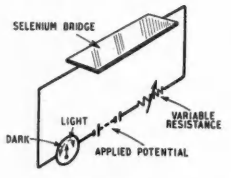
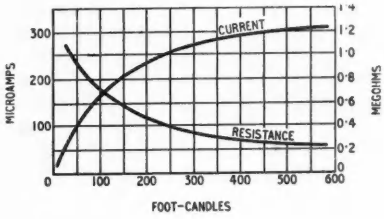


Fig. 1

Fig. 2
(*Below*)



* The term "noble" is an old one, meaning a metal that is chemically inert and so does not oxidize easily. Metals are rendered inert largely by cold evaporation treatment, which applies to them a surface layer of tellurium, tantalum or rhodium—common choices in preference to silver and gold which are objectionable in some cases on account of their tendency to form sulphides.

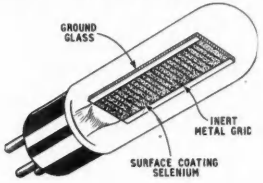


Fig. 3

ase plate (Fig. 4) and light striking the ell induces a transfer of electrons between ie surfaces of the selenium and the metal ayer so that a negative charge is built up ver this layer. The current which may be btained from such a charge when the cell connected to an external circuit is ppreciable and can reach the order of veral hundred microamperes with an lumination of 100 ft-candles. It is a latively simple matter to connect a umber of such cells in series and obtain i increased effect.

Rectifier cells are commonly referred to barrier layer cells since it is at the oundary surface, or barrier layer, between e selenium and inert metal that light nergy is transformed into electrical energy. Their characteristics are largely determined by the internal resistance of the cells themselves. Selenium itself is only a semiconductor and considerable scope is available for matching the final resistance of the cell to any desired external circuit. Low-resistance barrier cells have a resistance of a thousand ohms upwards. High resistance cells have a resistance of several megohms. In the former case light intensity is measured by current produced; in the latter by voltage generated.

The characteristics of a typical barrier cell as represented by current output against illumination is very nearly linear when there is little external load resistance.

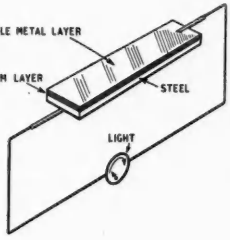


Fig. 4

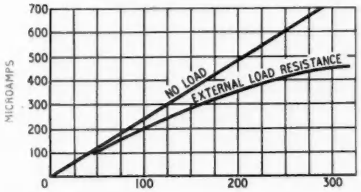


Fig. 5

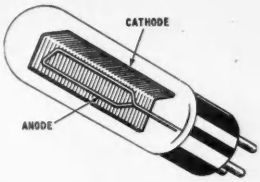


Fig. 6

The curve is flattened, something like that of the resistance bridge output, with increasing external resistance. This remark applies particularly to the low resistance barrier cells. Their chief advantage is their obvious simplicity and direct application. Unfortunately, although the characteristics of the response/illumination curve are good the resulting current values at the lesser-light end of the illumination scale (Fig. 5) are themselves extremely small and difficult to record or measure.

A further failing is that some cells of this type are sensitive to heat and to a lesser extent to humidity. Heat from a given light source may be sufficient to cause a false reading. A certain change in response with age may also occur. The majority of the modern commercial cells of this type, however, are free from these defects. Compensation of the circuit generally means, nevertheless, that the resulting scale of light intensity is not linear, if the instrument is designed for the direct quantitative measurement of illumination.

The true photo-electric, or emission, cell exists in several forms. Basically it consists of a cathode of generous surface area and made of an alkali metal (or with a coating of alkali metal) together with a wire anode which is usually in the form of a loop, all enclosed in an evacuated glass envelope (Fig. 6), the anode being maintained at a positive potential with respect to the cathode. With a fixed light intensity the current flow will increase with rising anode potential up to about 15–20 V, after which increasing anode potential does not promote any further electron flow from the cathode. The cell is said to be saturated. If now the light intensity striking the cathode is varied, it will modify the rate of emission of electrons and thus alter the current flow again. This variation of current will be in direct proportion to the value of the illumination of the cathode.

The cell can be made considerably more sensitive by using a gas-filled rather than

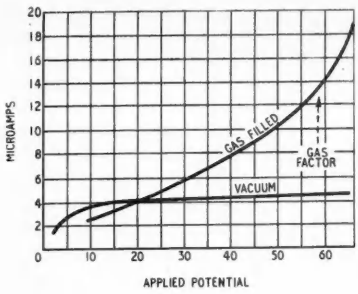


Fig. 7

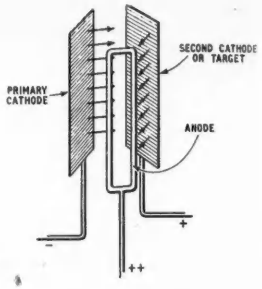


Fig. 10

an exhausted envelope. Increasing anode potential in a gas-filled cell promotes a progressive, and increasing, growth of current flow without any saturation point. The gas itself is ionized and enables a much greater emission current to be utilized, up to the point at which a glow discharge is started, which will be damaging to the cell.

The increase of emission current possible with a gas-filled cell is known as the gas factor. An absolute limit of between 8 and 10 for the gas factor is indicated. If this value is exceeded the stability of the cell becomes questionable, for it will be on the point of initiating a glow discharge between cathode and anode (Fig. 7) which might be precipitated by current variation induced by illumination of the cell. Increased sensitivity, in other words, is obtained only at the expense of decreased stability.

In a typical modern cell of this type the cathode is generally a silver plate with a thin surface film of caesium-silver oxide. The surface film can be selected to match the type of light to be measured or recorded. The caesium-silver cell has a peak sensitivity of around 7,500 Angstrom units (Fig. 8), corresponding roughly to infra-red light. Potassium peaks at a wavelength corresponding to blue light, silver in the red and infra-red range, and so on, typical examples being indicated in the diagram.

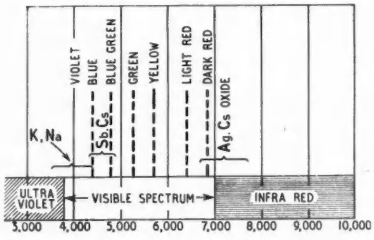


Fig. 8

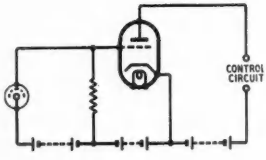


Fig. 9 (*Left*)

The sensitivity of the ordinary vacuum-type photo-electric cell is, however, extremely low and for purposes of practical measurement or control the output current is usually passed into a valve amplifier circuit, e.g., to the grid of a triode in a simple relay circuit (Fig. 9). A further type of two-stage emission cell has been developed, however, which has considerably increased sensitivity on its own. The principle of this cell is that two cathodes are employed with a common anode. The light-illuminated cathode is known as the primary cathode. The second cathode, usually called the target, has a positive potential with respect to the primary cathode. The common anode has a higher positive potential than both cathodes.

By suitable disposition of the electrodes and correct proportioning of the potentials, electrons emitted by the primary cathode are caused to strike the target, or second cathode, where they dislodge several more secondary electrons (by virtue of their impact) which travel to the anode (Fig. 10). The result is that a considerably greater emission current can be produced without upsetting the stability of the cell. The secondary emission cell, in other words, is comparable in performance with the gas-filled emission cell, without the instability of the latter type.

Copper Shortening

*Contribution to the Solution of a Turbo-Alternator Problem**

THE deformation, referred to as copper shortening, which occurs in the rotor windings of some large turbo-alternators has been a serious problem and now being further aggravated by the shift working of alternators to cope with peak hour loads.

Usual practice is to start an alternator with its windings cold, excitation being applied when the machine is running at speed. The effect of the centrifugal force on the windings in the rotor slots is to press them outward against the retaining wedge and hence increase considerably, by reason of the frictional forces, the resistance to lengthwise movement. The temperature rise in the copper windings produced by the field excitation current is greater than that in the surrounding parts of the steel rotor, which are heated by the copper.

Compressive Stresses

For this reason, and also because the coefficient of expansion of copper is approximately 50 per cent greater than that of steel, the copper will tend to expand lengthwise relative to the steel. This relative expansion is resisted by the frictional forces and consequently the copper is subjected to compressive forces in the direction of its length. If the compressive stress in the copper due to these forces exceeds a certain value, plastic deformation and creep in compression will occur. This creep will be in the nature of relaxation since, as it occurs, it will relieve the compressive stress and will progressively decrease as the stress is reduced.

The average temperature of the copper under normal running conditions will not exceed 130 deg C (B.S.225), although some parts may approach 160 deg C and under exceptional circumstances may even reach 190 deg C.

When the alternator is stopped the exciting current, being switched off, will no longer heat the copper on the rotor; contraction will occur now with considerably reduced frictional restraint in the absence of centrifugal forces. Thermal contraction of the copper will be greater than that of the steel and also the copper will have been shortened by any creep which occurred during operation. If the ends of the windings are not held rigidly against this contraction, the end coils will be pulled towards the rotor, leading in extreme cases to earthing faults after a number of repetitions of heating and cooling cycles. On the other hand, if the end coils are rigidly held against this contraction, tensile stresses will be set up in the copper.

Two different approaches to the solution of this problem have previously been tried. First, by applying the exciting current so that the windings are brought up to temperature before the alternator is run to speed. Thus the copper is free to expand and no stresses will be set up in it. Secondly, by rigidly fixing the end coils against contraction, combined with the use of hard drawn copper, which has initially a greater resistance to creep than annealed copper. Some earlier attempts to use h.d.c. did not overcome shortening and this has been attributed to softening of the copper at the operating temperature of the windings, which may be as high as 160 or even 190 deg C.

Clearly, if the copper used were capable of resisting without plastic deformation the compressive stresses imposed at the operating temperature, and of retaining this capability, shortening would not occur, and the necessity for rigid end-coil fixings, or preheating, would not arise.

Silver-Bearing Copper

The retention of the ability to resist plastic deformation is dependent on the resistance to softening of the copper with time at the operating temperature. Most additions to copper increase the resistance to softening at elevated temperatures, a notable effect in this direction being obtained by an addition of only 0·1 per cent of silver.

It was not known, however, what would

* Communication from the British Non-Ferrous Metals Research Association, Report T.M. 92P, based on R.R.A. 910P.

be the effect of silver addition on the resistance to creep of the high conductivity tough-pitch copper normally used for alternator windings. An investigation of this effect has been made in the laboratories of the British Non-Ferrous Metals Research Association. The rest of the present paper describes the interesting and, to the electrical power industry, valuable results obtained.

Table I—Softening of Coppers Cold Worked 10 per cent

Type of Copper	Time in hours to half-softening				
	at 130 deg C	at 175 deg C	at 225 deg C	at 250 deg C	at 300 deg C
Tough-pitch ..	100,000	1,200	30	<1	$\ll 1$
Silver-bearing tough-pitch ..	$\geqslant 1{,}000{,}000$	$\geqslant 1{,}000{,}000$	1,000,000	100,000	1,500
"O.F.H.C." ..	do.	do.	300,000	20,000	60
Silver-bearing .. "O.F.H.C." ..	do.	do.	700,000	60,000	750

Four types of high conductivity copper—(1) tough pitch, (2) silver-bearing tough pitch, (3) "O.F.H.C."[1] and (4) silver-bearing "O.F.H.C."—were obtained in the form of drawn strip 1½in wide by 0·1in thick, a size extensively used for alternator windings. The materials were in four degrees of cold work, that is 0, 10, 25 and 50 per cent. The two silver-bearing coppers contained approximately 0·1 per cent silver.

The electrical conductivities, in I.A.C.S.,[2] of the materials were in the ranges 100·8 to 101·6 at 20 deg C, of 69·8 to 70·7 at 130 deg C, and 63·2 to 63·6 at 170 deg C.

Relative resistance to softening was determined by holding samples of the coppers within the range 130 to 350 deg C and measuring the hardness after different times at these temperatures. In any one copper the resistance to softening is higher the smaller the degree of cold work initially in the copper. For example, at 175 deg C the times to half-softening of the tough-pitch copper were:

with 10% cold work .. .. 1,200 hours
with 25% cold work .. .. 150 hours
with 50% cold work .. .. 50 hours

As will be seen later, the resistance of the materials to creep was directly related to their resistance to softening and in this connection Table I indicates that the tough-pitch copper with silver, and the "O.F.H.C." coppers with and without silver, had similar resistances to softening and are all much superior to the tough-pitch material.

Resistance to creep was determined by stressing specimens in tension at various temperatures and measuring their increases in length with time. Some of the tests were run for periods up to 10,000 hours. Temperatures of testing were 130, 175 and 225 deg C. Stresses used ranged from 6,000 lb/sq in to 25,000 lb/sq in.

The creep tests showed that cold worked coppers which resisted softening at the test temperature were much more resistant to creep than those which softened during test, the annealed coppers being the least creep resistant. The softening tests had shown that heavily cold-worked materials are less resistant to softening than more lightly worked materials. Table II indicates that while the creep resistance of a given copper was markedly improved by 10 per cent cold working, no further improvement was obtained by heavier cold work. Thus it is clear that whatever copper is used the material should be in the cold-worked condition, but the cold work should not be unduly heavy, 10 per cent reduction being a suitable amount.

Table II—Effect of Cold Work on Creep. Silver-Bearing Tough-Pitch Copper at 175 deg C and 14,000 lb/sq in

Cold work per cent	Plastic creep strain after 2,000 hours at stress
0	6·4
5	0·60
10	0·12
25	0·09
50	0·11

The effect of silver on the softening characteristics of the coppers was closely parallel to its effect on the creep properties of the materials. Thus, while silver greatly improved the softening and creep characteristics of the tough-pitch copper, it had a much smaller effect on the "O.F.H.C." copper which was already relatively resistant to softening and creep. Of the four materials tested, the tough-pitch copper with 0·1 per cent silver, the "O.F.H.C." copper and the "O.F.H.C." copper with

[1] Oxygen-free high-conductivity copper.
[2] International Annealed Copper Standard.

·1 per cent silver all had similar creep roperties and were much superior to the ough-pitch copper. This fact is illustrated y the comparison of the silver-free and lver-bearing tough-pitch coppers in Table II which shows that at 130 deg C the eformation of the silver-bearing copper by reep is only one-third to one-sixth that of ie silver-free copper. At higher temperatures the difference is still more pronounced. In fact, it is clear hat at 175 and 225 deg C the lver-free copper, because it oftens, is not capable of carrying any but the smallest stresses.

In turbo-alternator rotor windings copper shortening is brought about by creep resulting from compressive stresses. In the creep tests used to compare the various coppers, tensile stresses were used because tensile equipment was available whereas compressive creep testing is difficult to carry out. However, there is every reason to expect that the great superiority of the silver-bearing over the silver-free copper in tensile creep testing would also be shown in compressive creep testing. Thus the superiority is due to (a) increased resistance to softening, and (b) increased resistance to creep due to the addition of the silver atoms to the copper lattice. Both these factors would be equally effective under compressive and tensile conditions of stressing.

It is concluded therefore that copper shortening can be considerably reduced, if not entirely eliminated, by the use of cold-worked silver-bearing tough-pitch copper instead of silver-free copper. The recommended degree of cold work is 10 per cent; this imparts the required resistance to creep with maximum resistance to softening.

Table III—Comparison of Creep of Silver-Free and Silver-Bearing Copper

Test temp deg C	Stress lb/sq in	Creep Strain, per cent			
		at 1,000 hours		at 5,000 hours	
		Silver-free	Silver-bearing	Silver-free	Silver-bearing
130	8,000	0·06	0·02	0·10	0·03
	14,000	0·16	0·04	0·36	0·06
	20,000	0·64	0·12	B 1,750 hours	0·15
175	8,000	0·16	0·04	0·62	0·06
	14,000	1·12	0·09	B 1,100 hours	0·12
225	6,000	3·0	—	—	—
	8,000	—	0·09	—	0·15
	14,000	—	0·20	—	0·39

B = broke.

A more metallurgically detailed description of the work outlined appears in the *Journal of the Institute of Metals*, November, 1951, *80*, 121–142: "The Creep and Softening Properties of Coppers for Alternator Windings," by N. D. Benson, J. McKeown and D. N. Mends.

Design of Servomechanisms

AT an I.E.E. Measurements Section meeting this week two papers were presented relating to the design of servomechanisms. The first of these, which was prepared by Miss Pei-Su Hsia, Ph.D. (Electrical Engineering Department, Heriot-Watt College, Edinburgh), deals with a graphical analysis for non-linear systems and was read by Prof. M. G. Say. The paper develops a graphical analysis for the solution of second-order differential equations for systems with non-linear damping and restoring forces and with arbitrary drives. The construction for the general type of differential equation is shown, the errors are discussed, some practical problems are evaluated and the results are compared with experimental solutions or those from other methods.

The second paper, prepared by Mr. J. C. West (Electrical Engineering Department, University of Manchester), describes a system where both the coarse and fine measuring elements normally employed in a high-precision position control servomechanism can be used simultaneously without switching from coarse to fine. The steady state accuracy of the whole mechanism is shown to be the same as that of a conventional coarse-fine change-over system. The stability of this new system is sensibly that which would be obtained using only the coarse measuring elements.

Guide to Industrial Relations

THE Industrial Administration Group has published a new edition of its "A Concise Guide to Industrial Relations," by T. Wylie, which has been revised and enlarged to cover the latest regulations contained in the Industrial Disputes Order, 1951, the implications of which affect almost every aspect of negotiations between trade unions and employers' associations. The new edition is available (2s 6d net) from the Group, College of Technology, Suffolk Street, Birmingham, 1.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Boards and Districts

REFERRING to the article by Mr. W. Walsh in your issue of 30th November, if a large group of companies, often with world-wide ramifications, can be controlled satisfactorily from London by a very moderate number of executives and assistants, surely an Area Board headquarters should be able to control, say, twenty Districts and exercise control with a total headquarters staff most certainly not exceeding 150.

Such a method presupposes that the District managers are of such quality and experience that they can exercise their duties and responsibilities rather more freely than is the case in most Area Boards. If there is not a greater degree of trust it naturally follows that the headquarters staff will become unwieldy with personnel authorized to give decisions on more or less trivial matters.

At a B.E.A. Summer School at Horsley Towers, Mr. C. R. King, chairman of the East Midlands Electricity Board, read a paper on organization in retrospect and prospect and a précis of that paper appeared in a recent issue of the East Midlands Electricity Board's *Journal*. Mr. King stated, *inter alia*, that at headquarters they were more and more inclining to the view that if the East Midlands Area, now comprising eight Sub-Areas and some thirty Districts, were reorganized into seventeen or eighteen larger Districts, each under a District manager directly responsible to headquarters, there would be greater efficiency and a great saving in administration costs. Mr. King further mentioned that the city Sub-Areas, such as Nottingham, Leicester and Coventry, which controlled no outlying districts, were, in fact, a form of two-tier organization running very satisfactorily.

Mr. King also suggested that as certain matters could be dealt with efficiently by some centralization, such as mechanized billing of accounts, he visualized, say, three centres, not necessarily related to any particular Districts, which he termed "printing houses" only for such work. In other words, all accounting would be in the District or at headquarters with no intermediary

He also visualized three or four engineering units, again not related to any particular group of Districts, but strategically placed in respect of the network. Obviously, such units might be responsible for certain main transmission lines that could not become the divided responsibility of several Districts, and I imagine they would do bulk testing of meters, etc.

This seems a very commonsense and businesslike arrangement with decentralization and centralization nicely balanced, and it is to be hoped that it will be given an early trial by completely detaching some District from its present Sub-Area, using Sub-Area facilities purely as a printing house and an engineering unit for obvious services.

I hear no good word of the so-called "double-headed" Districts—from consumers or others who have to deal with them. The smallest ship has a captain, so should the smallest District have a manager. This idea was tried out years ago in private enterprise with a resident engineer and a commercial manager, each responsible to the directors, and it failed miserably.

DISTRICT MANAGER.

Installation Regulations

RULES of any kind must be hard and fast if they are to serve any useful purpose but the I.E.E. Regulations for the Electrical Equipment of Buildings are not unlike the Ten Commandments, in so far as they are more often broken than obeyed. Because there is no machinery in existence to enforce the Rules, they cannot be regarded as anything other than recommendations.

Shoddy electrical installation work has been the rule for many years and even in this enlightened era it still exists; indeed there is a large number of men at present posing as skilled journeymen who do not even possess electrical common sense, let alone understand rules.

Even the factory inspector cannot " come to grips " with this matter because of the smallness of his staff and if instead of spending money on wild-cat schemes, some of it was diverted in this direction, something worth while would be attained. There are of course, no electrical inspectors for business or domestic premises and many supply authorities (who should uphold the rules) have connected atrocities to their mains, apparently being more concerned with revenue than regulations.

The N.R.E.I.C. has been in existence for over twenty years and, although it has struggled against odds, it has regrettably failed. The proposed new inspectorate may possibly bring about some improvement but even that will remain to be seen.

No good purpose can be attained by criticism unless it is constructive. I have expressed my views on this subject many times as readers of the *Electrical Review* will be aware, and have suggested the remedy.

Glasgow. ALEX. MILNE, Sen.

The Case for Tramways

YOUR correspondent Mr. W. Broom (*Electrical Review*, 30th November) has drawn attention to only part of a regrettable policy which is being followed all over the country. This policy consists of the abandonment of all forms of electric traction on the streets of our towns, whether trams or trolley-buses. A number of large towns are replacing their tramways by motor buses; even worse, there are some which are scrapping trolley-bus systems.

In a large number of cases this policy is due, I feel, to the fact that transport managers are unwilling or incapable of taking the responsibility for installing and maintaining the overhead system and supply arrangements for a trolley-bus system. A minimum of responsibility is required to operate a fleet of motor buses.

Until there is a little more initiative and enterprise in developing the most suitable forms of transport, the travelling public will be subjected to an ever-increasing charge for a deteriorating service.

Edinburgh. M. BURNBY.

Correlation

REFERRING to the article by Mr. E. J. Wood (30th November), it seems rather unusual to assume odds of 100 to 1 in connection with the significance of the correlation coefficient. In statistics a significance level of 5 per cent (*i.e.*, 20 to 1) is generally assumed, unless there are special reasons to depart from this. The result of choosing a 5 per cent level would, of course, be a new curve (Fig. 1) nearer the horizontal axis.

A further point with correlation is that a mere linear relationship is not very illuminating, unless it can be stated within what limits there is a 95 per cent (or say 99 per cent) chance of the value Y (domestic demand) lying for a certain value of X (outdoor temperature). This will result in a " band," the width being dependent on the accuracy of the forecast required—with the regression line as its centre line.

In conclusion, it might be just as well to heed the warning that extrapolation applied to a regression line is most unwise, unless there is a very sound theoretical basis for it. Points outside the range investigated might quite easily affect both the slope and intercept of the regression line and it is always advisable to state the range of the independent variable to discourage extrapolation.

*Finchley, N.*3. W. L. GROSS, B.Sc. (Eng.)

Radio or Wire?

AT a discussion meeting of the Radio Section of the Institution of Electrical Engineers on 26th November the subject was: " Should Broadcasting be Superseded by Wire Distribution? " The discussion, which was opened by Captain P. P. Eckersley, covered three aspects of the subject, namely, whether three main programmes gave listeners sufficient choice and whether these should be provided by a monopoly; the economic advantages of one system over the other; and the technical difficulties underlying the provision of each of the two systems. There was no final agreement on whether some central body should be given the task of deciding " in the interests of the public " what programmes should be provided.

With regard to the method to be used for wire distribution, Capt. Eckersley described a device which had been developed utilizing the power-supply network; it had been made immune from interference from the various control impulses fed into the power network to operate street-lighting circuits, etc. On the other hand, a very large part of the network which would be necessary was already in existence as there were already over a million subscribers in this country connected to wire-distribution relay systems.

Twelve speakers took part in the discussion.

VIEWS on the NEWS

By REFLECTOR

THIS year being the centenary of the birth of Prof. Silvanus P. Thompson, Sir Arthur Fleming, as an old student of his at Finsbury 55 years ago, paid a tribute to his memory at an I.E.E. meeting last week. Sir Arthur recalled Thompson as a man always immaculate in appearance, never ruffled, who to start with inspired awe rather than affection in the students; affection came later. He was, however, a man of the most kindly nature and had many gifts; he was a good linguist, an artist of no mean calibre and a lover of music. He left behind him no record of great discoveries, but as a teacher he had few equals; his lectures were lucid and entrancing. He insisted throughout his life on the importance of the closest collaboration between industry and science. Though he carried out no great engineering works, he impressed and inspired hundreds of young engineers who came into the profession at a time when it was just being built up, and they had played their part in building up the profession and the industry of to-day.

* * *

It has been proved in South Wales that the Electricity Board lion and the contractor lamb can lie down together. In some other Areas the former seems determined to devour the latter. This may be a more natural procedure but it is not necessarily the proper one, particularly when the Boards have enough " on their plates " with their electricity distribution problems. Mr. L. Howles, the chairman of the South Wales Electricity Board, has set limits to its contracting activities—it does not propose to go into the radio and television business, for instance—and he believes in fair competition. Mr. Howles does not contemplate with equanimity the increase of staff which would be necessary if the local electrical contractors were to be supplanted. The cordial atmosphere which, as a visitor, I sensed at last week's Cardiff conference of South Wales Contractors and Board representatives is one which other Areas might cultivate, with advantage to the electrical industry in these difficult days.

* * *

A fortnight after he had connected an extension from the kitchen lamp socket a young Lancashire cotton worker was killed by it. From the evidence at the inquest it appears that 7 yards of flex led from the lampholder to a lamp in the scullery. There were two joins in the flex, one bound with insulation tape and the other bare for about an inch. As he passed through the door his head must have touched the bare wire, with fatal consequences. This unfortunate accident once again tragically draws attention to the serious danger arising from amateur electrical work, a point which I feel should have been stressed at the inquest. According to the local Press, the coroner commented that the victim of the accident had " only set up an electrical contrivance which hundreds of people set up every day " and went on to say it was unfortunate that he was not more careful in joining two wires and making sure they were insulated.

* * *

The official journal of the Madras Electric Trades Association refers to the effect on its members of the Indian Government's ban on the import of wires and cables under 0·0036 sq in. The time has now come, it says, when these cannot be readily obtained even at the abnormally high prices charged by Indian manufacturers. " If our Government pursues such policies it will not be long before the business of the already oppressed electrical contractors and merchants will be totally ruined." Paradoxically, the section of the journal in which the report appears opens with the remark: " To-day the world of trade offers more and better opportunities to ambitious men and women anxious to succeed in life than any other type of career."

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE following changes in the management of the Harland Engineering Co., Ltd., will take place on 1st January :—**Mr. C. A. Atchley**, who has been connected with the development of the business since its formation in 1903, retires from the managing directorship, having reached the age of seventy during the current year. He will retain his seat on the board. **Mr. R. W. Weekes**, sales director, will fill the vacancy created by Mr. Atchley's retirement while **Mr. K. W. Atchley** will continue to hold the position of works director coupled with that of chief of engineering. With a view to still further enhancing the specialization services of the Sectional Electric Drive Department, a wholly-owned subsidiary company is being formed, under the name of Harland Drives, Ltd., with the following as initial members of the board :—Mr. K. W. Atchley (chairman); Mr. F. H. Maddox (at present manager of the Drive Department—managing director); Mr. R. C. Mortimer (at present chief engineer of the Drive Department—technical director); and Mr. C. A. Atchley.

Enfield Cables, Ltd., announces that **Mr. Percy F. Deakin** has been compelled by ill-health to retire from active business, as from 1st November last. Mr. Deakin was educated at the East London Technical College (now Queen Mary College), and joined the Enfield Ediswan Cable Works, Ltd., as a draughtsman in 1919. He became the manager of the copper wire mill in 1923, and developed the copper rod rolling mill in 1926. He became works manager of Enfield Cable Works, Ltd., in 1932, and works director in 1943. Mr. Deakin retains his seat on the board of the company.

Mr. P. F. Deakin

Mr. R. G. Mukherji, M.Sc., A.M.I.E.E., electrical executive engineer, Northern Electrical Division, West Bengal Government, informs us that he has been appointed local sectional secretary for 1951-52 of the Engineering and Metallurgy Section of the Indian Science Congress Association. The Association is holding its 39th session in the first week of January and Mr. Mukherji will be glad to meet any overseas members who are attending.

Mr. W. H. Williams, a director of the General Electric Co., Ltd., has been elected president of the Electrical Trades' Commercial Travellers' Association for the year 1951-52, and **Mr. A. Watson**, a representative of the G.E.C., who has been associated with the electrical trade for many years, has been elected chairman. At the recent annual meeting of the Association, £350 was allocated from its benevolent fund to the Electrical Industries Benevolent Association, £225 to the Royal Commercial Travellers' Schools, £2 2s to the Commercial Travellers' Benevolent Institution, and £5 5s to the I.E.E. Benevolent Fund.

Mr. W. H. Williams

Mr. R. C. Moss, who completed fifty years' continuous service with the British Thomson-Houston Co., Ltd., Rugby, on 25th November, has been presented with a table model television set to commemorate the occasion. The presentation was made by Mr. E. S. Little, secretary and comptroller, before many of Mr. Moss's colleagues and friends.

Mr. J. Griffith Hall, director and secretary of Westinghouse Brake & Signal Co., Ltd., has been appointed to the board of Westinghouse Garrard Ticket Machines, Ltd.

Mr. Herbert Shackleton, M.Sc., M.I.E.E., technical engineer of the North Western Electricity Board's No. 3 Sub-Area, has been appointed technical and research engineer in the Chief Engineer's Department. He succeeds the late Mr. J. L. Carr. Mr. Shackleton, who is forty-seven, was educated at Burnley Grammar School and Manchester University. Before joining the Board's No. 3 Sub-Area in 1948, he was deputy engineer and manager with Rochdale Corporation Electricity Department. Previously he had served for twenty-three years with the Manchester Corporation Electricity Depart-

ment, being before his departure for Rochdale, electro-technical engineer and personal assistant to the distribution engineer.

At the invitation of the United Nations Educational, Scientific and Cultural Organization **Dame Caroline Haslett,** D.B.E., J.P., attended the U.N.E.S.C.O. Working Party on "Access of Women to Educational Opportunities" in Paris from 10th to 12th December, as an expert on technical education for women. She was also present in her capacity as president of the International Federation of Business and Professional Women.

Three promotions to the rank of chief scientific officer in the R.N. Scientific Service have been announced recently. They are of **Mr. J. Anderson,** C.B.E., M.I.E.E., chief scientist at the Admiralty Signal and Radar Establishment, Haslemere; **Colonel A. V. Kerrison,** director of Aeronautical and Engineering Research, Admiralty; and **Dr. E. C. S. Megaw,** director of Physical Research, Admiralty.

Mr. J. Anderson was educated at Spiers School, Beith, Ayrshire, and the Royal Technical College, Glasgow. After two years post graduate training in the Rugby works of the British Thomson-Houston Co., Ltd., he joined the Admiralty Experimental Station at Parkeston Quay, Harwich, in 1918, as an assistant physicist. He assisted Prof. R. W. Boyle in the very early stages of the development of Asdic equipment for the detection and location of submarines, and has been associated with the subsequent development of this equipment from 1918 to 1951, first at H.M. Signal School and later at H.M. Anti-Submarine Experimental Establishment. In 1943, on the death of Dr. J. K. Roberts, he became chief scientist at H.M.A.-S.E.E., which in 1946 was renamed H.M. Underwater Detection Establishment. He was appointed chief scientist at the Admiralty Signal and Radar Establishment in May, 1951. Mr. Anderson was appointed an O.B.E. in 1944, and C.B.E. in 1950 and holds the American Medal of Freedom.

Col. Kerrison was formerly superintendent of the Admiralty Gunnery Establishment, Teddington, and previously was superintendent of the Admiralty Research Laboratory, holding the joint appointment from 1943 to 1947.

Dr. Megaw, after graduation in electrical engineering at Queen's University, Belfast, spent two years as a Beit Scientific Research Fellow under the late Prof. C. L. Fortescue at Imperial College. His research on valve oscillators at high frequencies was continued after joining the Research Laboratories of the General Electric Co., Ltd., in 1930, where he spent sixteen years under the leadership of the late Sir Clifford Paterson. Specializing in the study of transit-time oscillators for the highest frequencies he soon began a long association with what was then the Experimental Department of H.M. Signal School, one of the results of which was that seagoing communication equipment using resonator-stabilized magnetrons was available at the beginning of the last war. During the war Dr. Megaw led a team which made many contributions to magnetron development, while he was also responsible for the G.E.C.'s part in the wartime studies of centimetric wave propagation under the ægis of Sir Edward Appleton's U.S.W. Panel at the Ministry of Supply. In

Dr. E. C. S. Megaw

A group at the E.C.A./South Wales Board conference at Cardiff (see page 1217). In the front row are (left to right) Mr. L. Howells (chairman, South Wales Board), Principal Robert James (member of the Board), Mr. R. L. Booth (chairman, South Wales Sectional Board, E.C.A.), Mr. J. G. Briggs (E.C.A.), Mr. R. Alger (E.C.A.) and Mr. P. G. Wallis (E.C.A.)

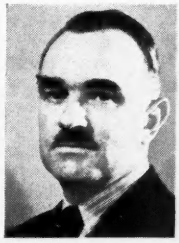
1946 he joined the Admiralty as superintending scientist at the Signal Establishment's radar extension, later becoming superintendent of research, R.S.R.E.

The St. John Ambulance Divisions of the **General Electric Co., Ltd.,** and associated companies held their annual competition at the Magnet Club, Witton, on 17th November, when six teams competed for the Gamage ambulance and nursing cups. At a ceremony which preceded the competition Mrs. Leslie Gamage, county superintendent of Berkshire, was presented with a silver key by Mr. J. J. Gracie, C.B.E., president of the Witton Divisions, and officially opened the new G.E.C. St. John headquarters. In the competition both trophies were regained by the Witton Divisions.

The Hon. Mrs. Leslie Gamage opening the G.E.C. St. John Ambulance headquarters at Witton. With her in the picture is Mr. J. J. Gracie, general manager of the Witton Works

Competitors and visitors were afterwards entertained to tea, following which the Hon. Mrs. Leslie Gamage presented trophies and prizes to the winning teams, and in response to a request from the Witton Divisions presented the new headquarters with a portrait of herself, painted by Richard Jack, R.A.

Mr. A. R. Cooper, M.I.E.E., M.Inst.F., controller of the Merseyside and North Wales Generation Division of the British Electricity Authority, and formerly chief operation engineer of the Central Electricity Board, has been appointed controller of the North Western Generation Division of the Authority in succession to the late Mr. C. T. S. Arnett. Mr. Cooper, who was educated at Rotherham Grammar School and Sheffield University, gained his early experience with John Brown & Co., of Sheffield and Clydebank, in the development of their power generation schemes and colliery and coke oven plant in Yorkshire. From 1928 to 1934 he was chief electrical engineer to Pearson & Dorman Long, Ltd., and organized their electrical development in the Kent coal field. He then became personal assistant to the late Mr. G. D. Mower, governing director of the Sturtevant Engineering Co., the Igranic Electric Co., and associated companies. In 1935 Mr. Cooper joined the C.E.B. as chief control engineer of the North West England and North Wales Area. Two years later he was appointed assistant to the chief operation engineer of the Board and, in 1942, operation engineer of the S.E. and E. England Area. He became chief operation engineer of the Board in 1944.



Mr. A. R. Cooper

Mr. L. Jones, who has been with the Albion Electric Stores, Leeds, for thirty years, has resigned owing to ill-health. The policy of the firm will continue under the direction of **Mr. J. H. Rogerson,** who has been joint general manager for some time past.

Mr. John Appleby, A.M.I.Mech.E., A.M.I.E.E., chief engineer, Punjab P.W.D. Electricity, Lahore, Pakistan, was due to arrive in this country on Tuesday last for a stay of about two weeks in connection with machinery for the completion of one of the major hydro-electric schemes in the Punjab. His address is White House, Abberton, Colchester (telephone : Peldon 224).

Mr. H. C. Shepherd, A.M.I.E.E., who has recently retired from the service of the British Electricity Authority, Yorkshire Division, after twenty-three years as station superintendent at Thornhill power station, was the chief guest at a gathering on 30th November when a presentation was made to him on behalf of his colleagues. Mr. G. A. Vowles, divisional controller, was among those who

attended. Mr. Shepherd joined the staff as a shift charge engineer in 1919 and after a number of years in charge at Barugh power station returned to Thornhill as station superintendent in 1928.

Mr. A. E. Kelly, A.M.I.E.E., retired from the service of the Glasgow Sub-Area of the South West Scotland Electricity Board on 30th November, after forty-one years' service in the industry. During his early years he was associated with the generating side and served as electrical superintendent at Port Dundas station. He was then appointed assistant substations superintendent and served in that capacity until vesting date, when he was appointed Sub-Area engineer, in which capacity he continued until his retirement. Mr. Kelly took an active part in the formation of the Electrical Power Engineers' Association, and was the first hon. secretary of the Scottish Division.

As from 1st January, **Merz & McLellan** are taking into partnership Mr. A. E. Powell, Mr. E. L. E. Wheatcroft, Mr. H. J. Beard and Mr. W. H. Dixon, who have been members of their staff for a number of years. Mr. Powell will normally be at Newcastle, Mr. Wheatcroft and Mr. Beard at Esher, and Mr. Dixon at the London office.

The directors of **Daly (Condensers), Ltd.**, Mr. H. C. Daly and Mr. P. B. Renshaw, invited the staff to dinner and a visit to the London Palladium on Friday last.

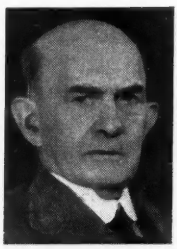
The annual dinner of the **Wholesale Fittings Co., Ltd.**, was held on 1st December at the Tavistock Restaurant, Charing Cross Road, London. Over 150 of the staff and guests were present, and speeches were made by the chairman, Mr. J. Altman, who founded the company in 1893, and Mr. D. S. Rose (director). A telegram was read from Mr. F. C. Barnett (managing director) who was unavoidably absent, wishing all present a happy evening. The dinner was followed by a dance and cabaret show.

Employees of **Arrow Electric Switches, Ltd.**, held a social and dance at Ealing Town Hall on 4th December. The hall was gaily decorated for the occasion and there were several spot prizes as well as a huge basket of fruit for the holder of the lucky entrance ticket.

OBITUARY

Mr. G. Griffin Smith, whose death occurred on 5th December at the age of sixty-one, had been educational instrument sales specialist for Crompton Parkinson, Ltd., since July, 1945. During the last war he was for two years production officer of the Aircraft Instrument Section of M.A.P., and then went to the Aircraft Instrument Department of Amalgamated Wireless (Australasia), Ltd. From 1919 to 1939 he held appointments with two instrument manufacturers.

Mr. H. J. Norballe.—The death occurred on 2nd December, at the age of eighty of Mr. H. J. Norballe, founder and senior director of the Watford Electric Manufacturing Co. Ltd. Mr. Norballe, who was a naturalized British subject, was born in Denmark where he received his training as an engineer. After several years in the United States, he came to this country in 1900 and founded the business of Thomas Kesnor & Co., Fulham, in partnership with Mr. T. Fulkes. The concern became a private limited company in 1908, removing to Watford in 1911, and changing its name to the Watford Electric & Manufacturing Co., Ltd., in 1916. The business was formed into a public company in 1936. Mr. Norballe, who was actively associated with all these changes, was the company's technical representative on the B.E.A.M.A., and as the company's chief engineer and designer had been responsible for the design of many of its products. He was still actively connected with it at the time of his death.



The late Mr. H. J. Norballe

Mr. H. E. Ellis.—The death occurred on 4th December at the age of eighty-one, of Mr. Herbert Edward Ellis, governing director of the City Electrical Co.

WILLS

Mr. W. F. Mitchell, A.M.I.E.E., consulting electrical engineer, who died on 27th June last, left personal estate in England and Scotland valued at £8,793.

Mr. J. Whipps, sales manager of the General Cable Manufacturing Co., Ltd., Leatherhead, who died on 10th July last, left £8,448 gross (£7,532 net).

Gas Council's Report

A SURPLUS of £1,492,784 on the operations of the gas industry in 1950–51 is recorded in the second annual report of the Gas Council. Nine area boards showed surpluses totalling £2,079,192 and three reported deficits amounting to £573,166. Sales aggregated 2,460 million therms, an increase of about 5 per cent, and the number of consumers rose by 120,000 to 11,981,000. At a Press conference the deputy chairman, Col. H. C. Smith, said that the higher freight charges and increased cost of coal would make it necessary to raise the price of gas next year.

Industry and the House

Effects of Financial Restrictions

By T. F. COOK, M.P.

PARLIAMENT worked out its last week before the Christmas recess with a big flare-up on housing. The Government found itself largely on the defensive in the debate. Questions on the method of obtaining 300,000 houses a year were asked and largely unanswered although the Government has stated that it does not think it can reach this figure by 1952 or even 1953. In the absence of a clear expression of Government policy the House is in some confusion, what with the statement of the Chancellor on cuts in capital expenditure, and that of the Minister of State for Economic Affairs on cuts in local authority spending, coupled with the new Bill to amend certain parts of the Industrial and Provident Societies Act of 1893.

Industrial and Provident Societies

The effect of this Bill is to raise the limit of a member's shareholding from £200 to £500, and to increase from 10s to £2 the maximum payment which may be taken at one time from a depositor and from £20 to £50 the total which an industrial and provident society may take on deposit from a member without the society being deemed to do banking business.

The main purpose of the Bill seems to be to assist in house purchase. But here again the issues are not quite clear. On the one hand the Government seems determined to cut public and private expenditure on non-essentials and on the other to make spending easier. But it may, of course, encourage private saving which is a very desirable objective indeed.

The long recess is unfortunate in that there will be many statements of policy made while the House is not sitting and consequently no opportunity for members to question Ministers with a view to clarification of the effects on industry and the country generally.

These statements are inevitable in view of the rapidly changing economic situation, and a shorter recess seemed appropriate in these circumstances. For instance there will be pretty hard knocks for a fairly large number of firms as the result of the new directives sent along to the Capital Issues Committee by the Chancellor of the Exchequer. The Chancellor's directive strikes very hard on issues needed to pay off bank advances.

Effect of Capital Issues Directive

In essence Mr. Butler has told the Capital Issues Committee chief, Lord Kennet, that he has to ignore completely that the money has already been borrowed and to take into account only the " eligibility of the purposes " for which it is wanted. In fact, no export or defence work, no new issue. This may quite possibly have a disastrous effect on the radio and television industries as well as on makers of vacuum cleaners, refrigerators, washing machines and a variety of similar appliances. Only dollar earning, dollar saving or defence industries will be exempt from the new issues ban.

One good feature of the new directive is that the ban also applies to new issues for putting through speculative deals in property which may put an end to the " buy or quit " terms made to a very large number of firms in recent years. The Chancellor has thus added a third clamp: first, the use of manpower; second, the use of raw materials; and now the use o money.

Under the new policy, industries doing the wrong sort of job and which have borrowed from the banks until they could raise more money in the City, may well find themselves, unless they come under the permitted heads, in extreme difficulties. They are faced with the major problem of how to pay off their overdrafts if Lord Kennet's committee gives them a blunt " No." This answer seems inevitable in a great many applications because he has instructed the committee to be " vigorously critical."

Similarly, the banks have been told that,

among other things, they must not lend money if it is to finance hire-purchase sales. They also ban loans for "speculative buying of securities, real property, or stocks of commodities," and bankers must not lend money to companies "for capital expenditure," for instance, in the provision of new factories. It will be interesting to see what action the Government will take to close the obvious loopholes in the hire-purchase ban, because the large trading organizations such as the Co-operative Societies, the nationalized gas and electricity industries and the big stores do not need to go to the banks, but can quite well use their own funds for financing hire-purchase.

The defence debate was somewhat of an anti-climax with the Prime Minister handing out compliments right and left for the excellent planning and policy in the defence programme of the previous Government; indeed at one stage it looked as though he had ordered the setting up of a new department for the manufacture of haloes for the heads of former Ministers!

In the new Parliament events have so far moved rather quietly; the real battles have still to come, the biggest of which will be the Budget debate, together with the discussions on steel and transport. But during the next six or seven weeks a great many memoranda of instructions will go out from Downing Street, with far-reaching effects on both sides of industry. The officials of the various trade and industrial associations are in for a very busy time endeavouring to answer their members' many new problems.

These articles do not set out to answer such queries but to analyse the impact of Government action on industry, with particular emphasis on the electrical industry, and to convey something of the atmosphere of the place where announcements are made, the House of Commons.

PARLIAMENTARY NEWS

From Our Special Reporter

IN the House of Commons last week Mr. Rankin asked the Secretary of State for Scotland what changes in the status or functions of the North of Scotland Hydro-Electric Board he proposed to make.

Mr. Stuart said he did not contemplate any change in the organization of the electricity industry in Scotland that would impair the special responsibilities for the Highlands and Islands which were placed on the Board by the Hydro-Electric Development (Scotland) Act, 1943.

Replying to Mr. M. K. Macmillan, Mr. Stuart said that he was informed by the North of Scotland Hydro-Electric Board that the potential water power of North Uist was surveyed some time ago but the results of the survey were not promising. There were, therefore, no plans at present for hydro-electric development in the island. The Board hoped, however, to distribute electricity in most of North Uist in due course.

Power Lines in Snowdonia

Dr. Stross asked the Government to ensure that electricity lines in the Snowdonia National Park should be laid underground. The cost charged to the users of electricity would amount to only one-thousandth part of a penny per unit over 20 years; if this was not acceptable to the British Electricity Authority, the money could be taken from the National Land Fund.

Mr. Marples, Parliamentary Secretary, Ministry of Housing and Local Government, said that the cost of laying wires underground would be extremely high. Dr. Stross's estimate was only for the capital cost of laying the wires underground; he had neglected to take into account the maintenance cost.

Steel Scrap

Mr. Sandys, Minister of Supply, told Wing-Comdr. Bullus that stocks of iron and steel scrap held at the end of December, 1949, March, 1951, and September, 1951, by iron and steel foundries, expressed in terms of their average weekly consumption in the June–September quarter, 1951, were: Iron foundries 3·8, 3·8 and 4·3 and steel foundries 3·7, 4·4 and 4·9 weeks' stock. Iron foundries used about seven times as much scrap as steel foundries.

V.H.F. Broadcasting

Mr. C. I. Orr-Ewing asked the Assistant Postmaster-General whether he would set up immediately a committee to consider the development of very high frequency broadcasting in this country in view of the unsatisfactory service in many areas now dependent upon medium and long wave reception.

Mr. Gammans said that the Postmaster-General recognized the desirability of improving the coverage of sound broadcasting in the United Kingdom by v.h.f. broadcasting, but extensive developments could not be carried out without regard to the effect on capital investment. Until the Government had reviewed the recommendations of the Broadcasting Committee, it would be premature to adopt the proposal.

Defence Equipment

During the debate on defence, Mr. C. I. Orr-Ewing raised the question of radar equipment for the Forces, and said he was convinced we were not getting the best value for money. We were not getting our equipment in time because we had set too high a standard. The K114 specification, which was very rigid and hard, asked that all equipment to be manufactured for the Forces should be capable of operating from the Arctic to the Equator. It was costing £500,000 to develop this equipment, and one-third of that sum was required because of the K114 specification. Yet 90 per cent of this equipment would be used in the temperate zones. He urged the Government to look into this and, if necessary, to reduce the very high standard it had set.

Mr. Head, Secretary of State for War, said that Mr. Orr-Ewing's remarks were of intense importance, and he would go into them carefully. He agreed that we must have good equipment, but there were certain refinements which could sometimes be sacrificed.

Heavy-Oil Engines

Report on Working Costs

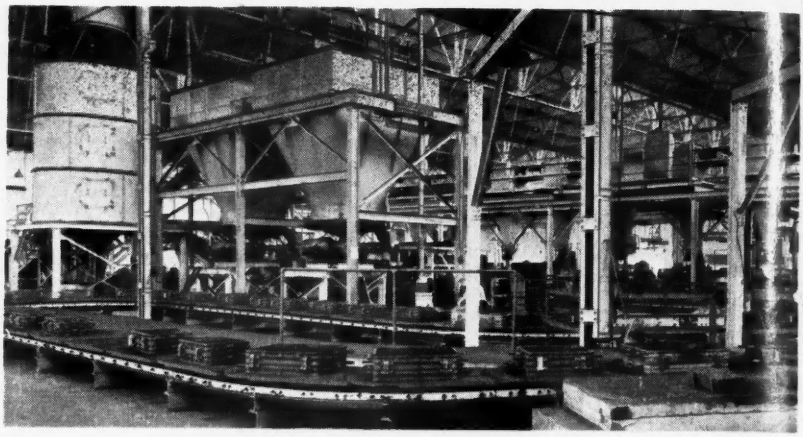
IN the report of the Diesel Engine Users' Association on the working costs of heavy-oil engines in 1949–50, figures are given for 69 land undertakings and—a new feature—18 ships. Information is presented mainly in six comprehensive tables divided into two sections, i.e., installations containing mechanical injection engines only and those in which air-blast types are also included.

In the list are eleven electricity generating stations of the British Electricity Authority and ten of the North of Scotland Hydro-Electric Board, seventeen waterworks and thirteen miscellaneous stations abroad, the remainder being private generating plants in this country. Two of the tables relate to mechanical details and their maintenance. Particulars of performance in the marine section are less complete owing to inability to measure the power developed by the engines and consequently the fuel consumption and cost based on horse power. Average long-period costs per kWh generated, some for seventeen years (1922–1939), are set out for 36 stations. Supplementary charts show differentiated costs under the various categories and average results obtained. There are also numerous comments by members on their experiences.

Returns from 39 home stations show that these contained 183 engines of 64,000 kW capacity in all, which generated 89 million kWh, meeting a maximum demand of 49,000 kW with an average station load factor of 15·9 per cent and a running plant load factor (the ratio of total kWh generated to the kW rating of each set multiplied by the number of its running hours) of 63·3 per cent. The average price of fuel oil (23,500 tons), having a calorific value ranging between 18,000 and 19,670 B.Th.U/lb, was £11 17s per ton and, at 0·593 lb per kWh generated, cost 0·754d. Lubricating oil (88,000 gal) at 5s 3d/gal cost 0·062d per kWh, water and stores 0·017d, operating wages 0·19d, and repairs and maintenance 0·130d, the total engine cost per kWh generated amounting to 1·167d. For 13 overseas stations the overall cost worked out at 1·135d/kWh and for 17 home waterworks 1·270d/water h.p.-hr.

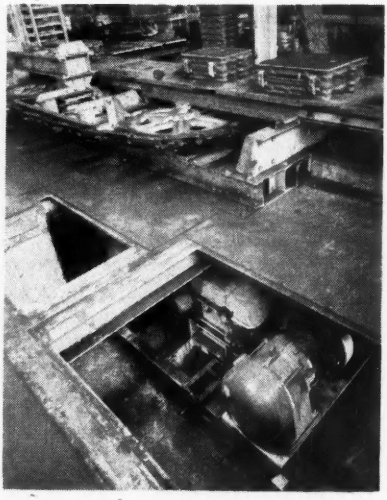
Stores Control

UNDER the auspices of E. G. Brisch & Partners, Ltd., a party including representatives of the Ministry of Supply, the British Engineers' Association, the British Standards Institution, the Anglo-American Council on Productivity, the Board of Trade, etc., visited the primary materials store at the Union Works, North Wembley, of the General Electric Co., Ltd. There they inspected the Brisch system of stores coding, classification and standardization which has been operating for some time. The objects of the system are the elimination of unnecessary varieties of materials and the recording, arranging and controlling of the rest. It is claimed that by these methods the redundant stock has been substantially reduced and handling has been greatly facilitated.



Mechanized Foundry

Output Facilitated and Increased



One of two 7·5 h.p. motors which drive the mould conveyor track

WITH the object of increasing output and of attracting young men to come forward to learn the trade, Smith & Wellstood, Ltd., makers of "Esse" cookers and heating stoves, have built a mechanized foundry at Bonnybridge, Stirlingshire, which was opened earlier this year.

Thirty-six Brook motors, ranging from a 0·33 h.p. "Cub" machine to a 15 h.p. surface cooled type, are used for motive power, either on the casting conveyors or on the sand preparation and cleaning equipment.

Capable of producing 120 tons of good castings per week this foundry is designed to give a high rate of production while lightening the heavy labour generally associated with floor moulding. For example, the molten iron is poured into moulds from large ladles, suspended from overhead monorail trolleys, in place of the usual small hand ladles. The manual method is, however, retained for smaller castings which are cast on a moving conveyor. Two 7·5 h.p. motors direct coupled to reduction gearing provide the motive power.

Moulds are prepared by pneumatically and electrically operated machines. By this method, the moulding box is placed on the platform of the machine, which contains the pattern, and filled with sand from a hopper directly above it. The platform then rises mechanically and the sand is pressed into the shape of the pattern. A 10 h.p.

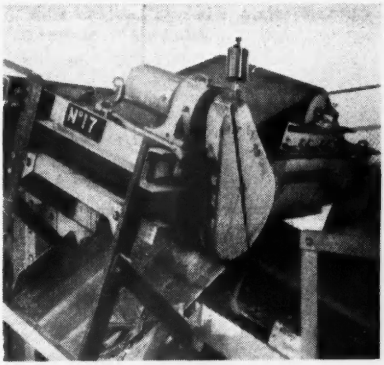
surface cooled slip ring motor drives the sand hopper rotary discharge table.

The box with the sand mould is then removed and placed on a moving conveyor which takes it to the casting station. Larger moulds travel on a roller track, fitted with pneumatic lifts for raising or lowering the boxes to tracks at different levels.

After pouring and cooling, the castings are separated from the metal boxes by "shake-out" machines, the sand falling through grilles to an underground conveyor belt. Large quantities of sand are prepared and used every hour, and practically no hand work is involved. From the "shake-out" machines, it travels on a series of conveyor belts up to the preparation plant. On the way, any particles of metal are removed by magnetic separators. In the preparation plant the sand is broken up, screened, watered, milled and aerated at the rate of 60 tons/hour. It is then fed back by conveyor belt to the hoppers over the moulding machines.

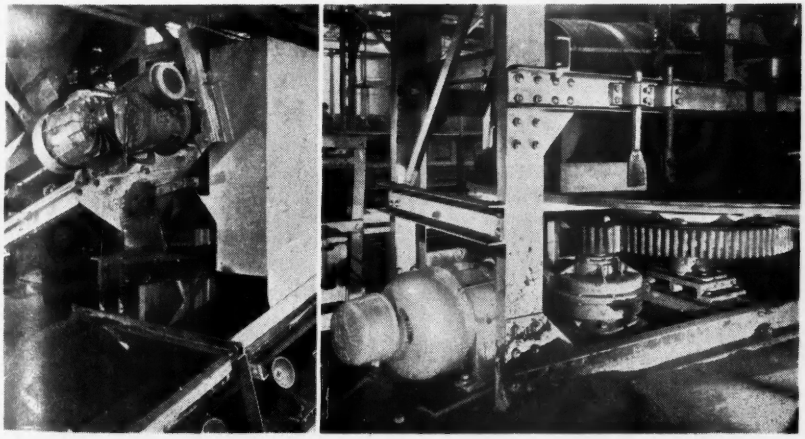
An overhead casting conveyor system, driven by a 5 h.p. motor, does away with the necessity for trucks or other smaller vehicles on the floor of the mechanical moulding shop. Carriers, suspended at regular intervals from a conveyor chain, move continuously through the foundry, the speed being regulated to suit the rate of production. Castings and surplus metal, known as "ingates" and "runners," are placed on the carriers at the "shake-out" points. The surplus metal is taken off at the cupola platform for remelting, while the castings remain on the carriers till they reach the dressing shop. Here the castings are removed and the conveyor chain returns the empty carriers to the "shake-out" machines.

The entire plant is electrically controlled from a room overlooking the floor of the foundry. To avoid piling-up at any point, the switchboard is so designed that it is not possible under normal conditions to start or stop machines except in correct sequence.



Magnetic separator incorporating 0.5 h.p. motor

Left: **2 h.p. motor driving sand conveyor belt.**
Right: **Sand hopper rotary discharge table driven by 10 h.p. motor**



Voltage Regulation

Increasing Demand for Equipment

WIDE voltage fluctuations on electricity supply systems which result from insufficient generating capacity have a very serious effect on many industrial processes involving, for example, the operation of induction motors and electric furnaces, particularly high frequency furnaces. Voltage reduction means reduced heating and in many processes the heating time has been fixed and is kept constant by some automatic method; the quality of the material manufactured by this method will, therefore, be greatly affected by any voltage variations.

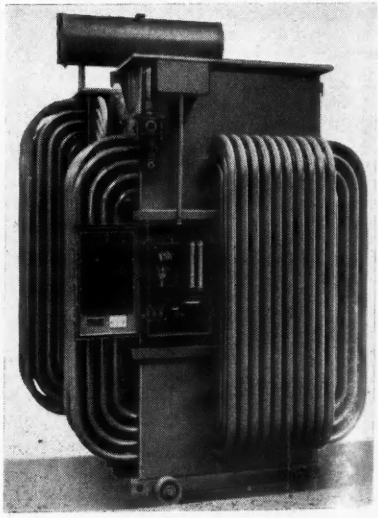
Another difficulty due to wide voltage fluctuations is the effect on the intensity of lighting which varies as the cube of the voltage; furthermore the life of electric lamps is greatly shortened by any increase of the voltage above its nominal value. It is even more serious that many of the fluorescent type of tubes will cease to operate altogether if the voltage is too low.

A greatly increased demand has, therefore, been created for voltage regulating equipment, to enable all types of electrical gear requiring a constant voltage to operate satisfactorily. To enable these demands to be met, and at the same time increase their range of products, Brentford Transformers, Ltd., Kidbrooke, one of the very few manufacturers in this country who specialize in this class of equipment, have recently considerably expanded their factory and installed a great deal of new plant. This will now permit them to manufacture regulators suitable for mains supply systems up to 5,000 kVA throughput. The fully automatic 3,000 kVA regulator illustrated was designed for operation on an 11 kV or 6·6 kV system.

Voltage fluctuations from 20 per cent below normal to 10 per cent above normal are quite usual nowadays, and these regulators can be designed for any voltage variation, the output being stabilized within plus or minus 1 per cent. The regulator is operated by means of a pilot motor, which in turn is controlled by a special voltage relay resulting in the stabilized voltage being independent of load, frequency, ambient temperature, power factor and current waveform. One of the other important applications of these regulators is the stabilization of d.c. supplies obtained from rectifier equipments. In this case the regulator is installed on the a.c. side, its voltage relay is connected to the d.c. busbars, so that the regulator will take care not only of supply voltage variation, but also of any drop in the rectifier and rectifier transformer, keeping the d.c. voltage constant within plus or minus 1 per cent under any conditions.

Automatic voltage regulators have in fact been used throughout industry for such purposes as the manufacture of seamless tubes, for the satisfactory operation of broadcasting stations and television studios, for the control of automatic plant in the textile, plastic, motor car and other industries, in each case combining the regulator with a suitable type of control gear.

Fully automatic 3,000 kVA throughput regulator for 11 kV or 6·6 kV systems



Board and Contractors

Harmony in South Wales

EVIDENCE of the excellent relationships between South Wales members of the Electrical Contractors' Association and the South Wales Electricity Board has afforded at a conference held in Cardiff on Thursday last week. It was the second event of its kind arranged by the E.C.A.-South Wales Electricity Board Liaison Committee which has now been in existence for over two years. Three papers were read and an informal dinner concluded the proceedings.

Mr. L. Howles, C.B.E., chairman of the Board, presided at the conference and in his opening remarks said that the causes of about 80 per cent of the complaints received by the Committee vanished when the matter was put into writing; the rest were easily settled by the Committee. Introducing the first paper (by Mr. H. J. Shaw, chief engineer, broadcast radio and television section, G.E.C.), which dealt with television service and interference, Mr. Howles said that it was not his Board's intention to engage in the television business although it would be expected to advise consumers about interference.

Mr. Shaw's talk covered television transmission and reception in a simple manner and particular attention was paid to the construction and erection of aerials. The speaker outlined the testing equipment needed by the television dealer and spoke of the training of employees for the servicing of receivers. He then gave demonstrations of the nature of interference with reception and possible remedies.

Installation Practice

After the luncheon interval Major A. G. J. Davy (E.C.A., Cardiff) presented a comprehensive survey of installation practice. He stressed the necessity of greater mechanization to counter the high cost of labour and referred to such aids as threading equipment, conduit benders, portable mechanical tools and stud welders. Following a brief reference to the training of operatives, Major Davy touched upon the "office" side, particularly estimating and costing. Wiring systems were next dealt with, the term covering non-ferrous conduits—aluminium, copper and plastic—and the flexible type recently introduced. The use of metal ducts for carrying cables and wiring, underfloor ducting, heavy-current solid-section systems and busbar distribution were other aspects mentioned.

In the ensuing discussion Mr. J. G. Briggs explained the inflatable tube method of forming wiring ducts in concrete floors, etc. Other speakers referred to possible trouble if aluminium conduit was embedded in plaster; the use of a cartridge-operated device for fixing studs in hard materials; the working temperatures of insulated tubing; the effects of inductive surges on mineral-insulated cables; and the value of carbide-tipped tools for cutting into concrete.

Protection Methods

The second paper of the afternoon was on the earthing of installations, by Mr. J. W. Bird, the South Wales Board's chief engineer, with an addendum by Mr. J. F. Smith (chief commercial officer of the Board). Mr. Bird pointed out that domestic consumers were responsible for the state of their own installations. The electricity supply authorities were handicapped by being able to discontinue supply only when an installation was likely to affect public safety or to interfere with the supply to other consumers. In other cases the procedure was too complicated, causing inordinate delay. Drastic alterations were necessary to allow the Boards to refuse to connect or re-connect faulty installations.

After stressing the desirability of the Boards and contractors educating the public in the matter of installations, Mr. Bird proceeded to quote a number of examples of dangerous work, largely the placing of switches on the neutral side and defective earthing, resulting in accidents, often fatal.

There followed a review of protective

methods—direct earthing; separate earth wire; protective multiple earthing; and earth leakage circuit breakers—in which the merits and failings of each were discussed. The increasing risks of relying on water pipes for earthing were mentioned and reference was made to an earthing fitting devised by the South Wales Board for clamping to cable sheaths.

Mr. Bird said that consumers should be encouraged to have their installations inspected regularly.

Mr. J. F. Smith traced the causes and passage of fault currents. He pointed out that the construction of the cases of many appliances did not ensure satisfactory earth continuity and that danger lurked in undiscovered breaks in the earth conductors of flexibles. He also drew attention to the deterioration of contact in the earth pins of plugs and the growth, with time, of the resistance of joints in earth wires. Earthing should not be dealt with as an afterthought but as an essential part of the installation. Appliances should be checked before sale, particularly with regard to earthing. The I.E.E. Regulations should prescribe more specific methods of earth testing.

Speakers in the subsequent discussion mentioned the attitude of water supply authorities towards the use of their pipes for earthing; it was said that the pipes in domestic premises were the property of the consumer and could be used as he wished, with certain limits. The registration of electrical contractors and operatives was advocated and Mr. Howles said that the Liaison Committee might consider sending a recommendation to the proper quarters. He thought that the provision of a proving house for appliances, also suggested, would be a simpler matter. It was thought that a line must be drawn between warning consumers against danger and frightening them away from electricity. The question of high neutral earth resistances at substations (up to 40 ohms) was raised. Mr. Bird admitted that these were rather high but expressed hope of improvement with properly planned systems.

At the informal dinner in the evening a film "River to Cross" was shown; it dealt with the proposed Severn Bridge, showing the selected site and a series of stability tests on models. Mr. Howells, who again presided, in proposing the toast of the guests, referred to the presence of leading E.C.A. members and the chief commercial officers from other Electricity Boards. He said that even before nationalization there was suspicion between contractors and electricity supply authorities. The Liaison Committee had shown that most of the difficulties were "human" problems and could be resolved by amicable discussion. The last thing the Board wanted to do was to get rid of the contractors; for one thing it would mean an enormous increase in staff.

Mr. A. F. Plummer, vice-president, E.C.A., replied to the toast. He said that the spirit and the letter of the "Memorandum of Agreed Principles" (between the Boards and the E.C.A.) had been observed extremely well. Referring to the obligations of both parties to the public he emphasized that everyone concerned, from the top to the bottom, should see that he gave a fair day's work for a fair day's pay.

The arrangements for this very successful conference were in the hands of Mr. A. King (S. Wales E.B.), secretary to the Liaison Committee.

Scottish Hydro-Electric Schemes

A NOTE of warning to those who see in the steady growth of hydro-electricity the end of the Highland problem was sounded by the Earl of Home, Minister of State, while on a two-day tour of the Highlands which included a visit to the Glen Affric project. He said that one must be careful not to claim too much for electricity, but, as part of a co-ordinated development plan in which new agricultural methods and the expansion of forestry could play their part, there were obviously great possibilities. The crofter and farmer would probably find that in times when labour was very short electricity was of added importance in their lives. In so far as it could ease the demands on coal, hydro-electricity could make an absolutely vital contribution to the national economy while, as for ability to compete with other countries, both in engineering and shipbuilding, it was absolutely vital that there should be a sufficient supply of power at the elbow of every workman.

A Highland sub-committee of Unionist M.P.s has been constituted to consider the operation of Scottish hydro-electric schemes, including construction costs and matters affecting consumers. Among the members are Major McCallum, Sir David Robertson, Mr. John MacLeod and Lord Malcolm Douglas-Hamilton, with the following from Central and Southern Scotland: Col. Gomme Duncan, Mr. Henderson Stewart, Comdr. Donaldson and Sir Wm. Y. Darling.

Commerce and Industry

Street Lighting Lantern Specification

Model of Large Boiler

THE British Standards Institution has published B.S.1788: 1951 which is devoted to street lighting lanterns designed for all classes of public thoroughfares. The Standard is in two parts, the first being devoted to lanterns for electric lighting and the second to lanterns for gas lighting. Both parts deal with the mechanical and constructional features of lanterns, exclusive of auxiliaries and lamps in the case of electricity, and excluding governors, ignition devices and controllers in the case of lighting by gas. The Standard is intended to make for safety, durability and ease of maintenance, but it does not purport to cover photometric requirements. It will be a useful addition to the Code of Practice for street lighting, Part I of which will be published shortly. Copies of this Standard may be obtained from the British Standards Institution, Sales Department, 24, Victoria Street, S.W.1 (price 3s, post free).

Paper Mill Lighting

The highest possible standards of lighting, both by day and night, were required at the new mill of Bridgend Paper Mills, Ltd., at Llangynwyd, near Bridgend, Glamorgan. Light in the right place, the working area, was the aim of the architects, Messrs. Henry Budgen & Co. of Cardiff and London, and this has been achieved by skilful control of massing and fenestration, coupled with the use of glass as a constructional material. An effective impression of the results achieved is conveyed by the accompanying night view of the factory. All the lighting equipment for the mill was supplied by the General Electric Co., Ltd., whose Illuminating Engineering Department worked in close collaboration with the mill executives and the consulting engineers (J. D. Crozier & Partners, Ltd.), in planning the installation.

Brush Acquire New Interest in Canada

The Brush Electrical Engineering Co., Ltd., parent company of the Brush ABOE group, has acquired a 31 per cent interest in the Diesel Equipment Co., Ltd., of Vancouver. One of the main functions of the Diesel Equipment Co., Ltd., will be the selling of large diesel engines, mainly marine, and generating sets manufactured by Vivian Diesels & Munitions, Ltd., and Vivian Engine Works, Ltd., the two Brush ABOE subsidiaries with factories in Vancouver. These factories manufacture engines of 35–600 b.h.p. and generating sets of 20–400 kW.

Christmas Holidays

The National Federated Electrical Association states that in accordance with the provisions of the contracting industry's paid holidays agreement, Christmas Day is a paid holiday in all areas of the country and operatives will be entitled to the wages of a normal working day. Those called upon to work will be entitled to double time for all hours worked and a day

Night view of the new mill of Bridgend Paper Mills, Ltd.

off in lieu for which they are to be paid wages at bare time rates for the hours constituting a normal working day. Boxing Day is a paid holiday in all areas of the country, with the exception of Bolton, Lancs. Operatives called upon to work will be entitled either to time-and-a-half plus a day off in lieu paid at bare-time rates, or, at the discretion of the employer, two-and-a-half times bare-time rates without a day off. New Year's day is a paid holiday at Blackburn and Bolton, Lancs, and payment should be as stated for Boxing Day.

E.C.C. Sales Conference

Representatives from all home district offices attended a sales conference of the Electric Construction Co., Ltd., held at the company's Bushbury Engineering Works, Wolverhampton, on 29th and 30th November. The delegates included a member of Tolley & Son, the company's representatives in New Zealand. The visitors were welcomed by Mr. W. M. Furniss (chairman and managing director) and Mrs. Furniss, at a reception on the evening of the first day of the conference. The assistant managing director, Mr. W. M. B. Furniss, presided at the conference. He was supported by Mr. W. Tonkinson (director and chief engineer), Mr. E. W. Walker (director and Birmingham area representative), Mr. J. Johnson Smith (director and London area manager), together with the senior executives from all departments of the works. Discussions ranged over the field of all the company's products including machines, switch and control gear, rectifiers, and transformers. The difficulties resulting from material shortages, especially of copper, sheet steel and bearings, were discussed.

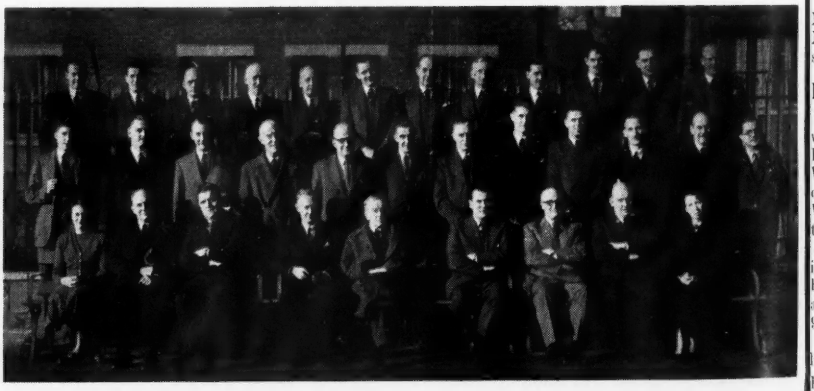
Two hundred members of the male staff attended the annual dinner at the Wulfrun Hall. The occasion was also a reunion, a number of retired personnel being present. Mr. E. G. Homewood proposed the toast of the company and its chairman and assistant managing director. Mr. W. M. B. Furniss, who replied on behalf of the chairman and himself, referred to the large volume of work on the books. The toast of the staff was proposed by Mr. J. Johnson Smith, and Mr. S. Clowsley responded. An entertainment followed the dinner.

Contract Price Adjustment Formulæ

The following are the latest figures for use in the B.E.A.M.A. contract price adjustment formulæ :—Rates of pay: the rate of pay for adult male labour at 23rd November shall be deemed to be 134s. Costs of material: the index figure for intermediate products published by the Board of Trade on 8th December is 375·4 and is the figure for November.

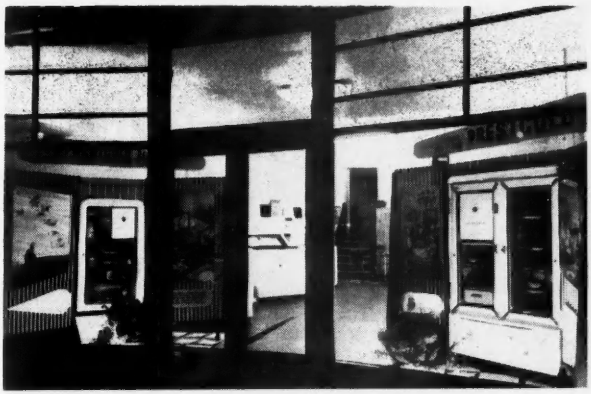
Colliery Inquest

When an inquest was held at Hetton (Co. Durham) on the miners killed in a gas explosion at Eppleton Colliery last July, the jury returned a verdict that the men died as a result of the



Representatives at the recent sales conference of the Electric Construction Co., Ltd.

Front row (left to right): Mrs. P. Attwood, Messrs. G. J. S. Drury (East Midlands), J. H. Charnley (Lancashire), E. W. Walker (director and Birmingham area representative), W. Tonkinson (director and chief engineer), W. M. B. Furniss (assistant managing director), J. Johnson Smith (director and London area manager), E. H. Vincent (works manager), and Miss Williams. *Middle row:* Messrs. R. Edwards (Manchester), R. Casebourne (North of England), G. W. Watson (South Wales), J. B. G. Northcott (Devon and Cornwall), W. Wrigley (chief service engineer), E. G. White (estimating), W. Anderson (service engineer—London area), B. Tolley (New Zealand), W. A. Mackay (London), R. H. G. Rice (London), E. N. Crosby (London), and W. A. Wells (advertising). *Back row:* Messrs. H. E. Laflin (Midlands), R. H. Bennett (London), T. Bull (chief of estimating), R. Jay (chief mechanical engineer), H. Sugden Binns (Lancashire), F. G. Furniss (Birmingham), W. Stay (deputy chief engineer), J. C. Milne (switch gear and rectifier manager), J. Noble (chief rectifier designer), F. Jenks (deputy works manager) and H. H. V...



The new Prestcold Refrigeration showroom at Manchester

explo on which had been
ause by an electrical
fault a Joy loader. The
jury dded that there
had en lack of super-
visio in the repair and
main nance of these
loade .

An lectrician, Mr. G.
Squir , gave evidence
that few days before
the plosion he found
the a aptor box on the
loade loose and tied in
place with shot-firing
cable The fixing bolts
for th box were broken
off. He said he carried
out temporary repairs
and was satisfied that
the loader was flame-
proof. He realized now
that the loader should
not have been used until proper repairs were made.

Mr. J. Avery, foreman electrician, said he had made a written report about the condition of the loader, but as he was transferred to other work he did not know if the matter had been attended to. Mr. B. Dobson, Senior Electrical Inspector of Mines, said there was an opening between the adaptor box and the master switch. Tests had shown that with a detached adaptor box sparks from the master switch could reach the external air and ignite the gas.

The Minister of Fuel and Power has directed Mr. Robert Yates, Deputy Chief Inspector of Mines, to make a special report on the explosion at the mine.

Pyrmont Boiler Plant Model

A half-inch scale model of the high-pressure water tube boiler plant nearing completion at Pyrmont power station, Sydney, New South Wales, is now on exhibition at the London offices of International Combustion, Ltd., 19, Woburn Place, W.C.1. It faithfully reproduces the boiler plant in every detail.

This is the largest h.p. water tube boiler plant in the Southern Hemisphere, incorporating boilers each having a capacity of 430,000 lb/hr at 1,280 lb/sq in, and a steam temperature of 950 deg F.

After being displayed in the principal Australian cities, the model will be used for instructional purposes in the Commonwealth.

Manchester Refrigeration Showroom

A new showroom for the Manchester branch of Prestcold Refrigeration was opened on Thursday, 29th November, at Prestcold House, Oxford Road, All Saints, by Mr. M. A. H. Bellhouse, assistant managing director of Pressed Steel Co., Ltd. The premises are conveniently situated on a busy main thoroughfare and the showroom contains a wide selection of items from the fully representative range of Prestcold refrigeration for domestic, commercial, industrial and medical use.

Sales Managers' Conference

The avoidance of waste in distribution was the subject of a conference held on Friday last at the Connaught Rooms, London, by the Incorporated Sales Managers' Association. The conference, which was divided into three sessions with an interval for lunch, was opened by Mr. R. H. Penney, chairman of the Association. The first session was devoted to methods for exploring and assessing a market, determining the sections which could profitably be attacked, charting the changing pattern of consumer wants, and evolving the basic sales plan. At the second session the training and briefing of the sales force was discussed and the final session dealt with receiving the co-operation of distributors.

At the luncheon, Mr. Penney presided, and installed Lord Luke as president in succession to Col. J. R. H. Hutchison, who resigned recently on receiving a Government appointment. Lord Luke, in speaking of the importance of training young men as salesmen, said that those salesmen who had reached the top of the tree should pass on their knowledge and experience to those who were to follow.

Radio and Television Reception

Holders of sound and television broadcast receiving licences who complain to the Post Office of interference to their reception of programmes will in future be given a pamphlet which tells them how they can make simple tests to ascertain whether the trouble is due to a faulty receiver or inefficient aerial and earth systems. Interference due to such causes should

not be referred to the Post Office Interference Investigation Service but should be dealt with by the owner of the receiver or his radio dealer. For use in cases where the tests indicate that the interference is due to causes outside the control of the owner of the set there is a form at the end of the pamphlet for enlisting the services of Post Office engineers to track down the source of the trouble.

At the end of October there were 1,031,950 television and 11,417,000 sound licence holders, a total of 12,448,950. The increase of 73,450 television licences during the month was the largest yet recorded.

Prices of Materials

In the accompanying table we give the prices of the more important materials used in the electrical industry. The figures are those quoted on Monday last.

ALUMINIUM Ingots	ton £124 0s 0d
COPPER, H.C. Electro ..	ton £227 0s 0d
Fire Refined 99·7 per cent ..	ton £226 0s 0d
Fire Refined 99·2 per cent ..	ton £225 10s 0d
COPPER Tubes	lb 2s 2d
Sheet	ton £280 0s 0d
H.C. wire and strip	ton £254 0s 0d
LEAD, English	ton £176 10s 0d
Foreign	ton £175 0s 0d
MERCURY	flask £73 10s 0d
TIN	ton £950 0s 0d
ZINC, G.O.B. Foreign ..	ton £190 0s 0d
Electrolytic	ton £194 0s 0d
BRASS Tubes	lb. 2s 1d
Sheet	lb 2s 4¾d
Wire	lb 2s 7¾d
PHOSPHOR BRONZE	
Wire	lb 3s 7¼d
RUBBER, No. 1 R.S.S. spot ..	lb 41¼d–41½d

Trade Announcements

The **Truvox Engineering Co., Ltd.**, Wembley, Middx., announces that J. W. Equipment, Ltd., 3a, Berkeley Place, Clifton, Bristol, 8 (telephone : Bristol 25655), have been appointed its sales agents covering Dorset, Somerset, Wiltshire, and Gloucestershire, and Mr. D. Annibal, 2, Rydal Mount, Chestnut Grove, Gedling, Nottingham, has been appointed its sales agent covering Nottinghamshire, Derbyshire, and Lincolnshire (excluding the Soke of Peterborough).

On 17th December **Lumitron, Ltd.**, are removing to larger premises at 180, Shaftesbury Avenue, London, W.C.2. The new telephone number will be Temple Bar 2900.

The London offices and stores of **S. O. Bowker, Ltd.**, are now at 34-36, Oxford Street, W.1. The telephone number remains the same.

Works Visit

The Prescot works of British Insulated Callender's Cables, Ltd., were visited recently by the Argentine Ambassador, Senor Don Carlos A. Hogan. His Excellency was accompanied by Senor Don O. A. Pombo, First Secretary, Argentine Embassy; Senor Don Sergio Derisi, Hon. Commercial Attaché, Argentine Embassy; and Mr. C. O. Haven of the Foreign Office, London.

Catalogues and Lists

Doran Instrument Co., Ltd., Stroud, Glos.—Technical leaflet on pH electrode systems.

Sturtevant Engineering Co., Ltd., Southern House, Cannon Street, London, E.C.4.—Technical brochure on pneumatic dust collecting and conveying.

Industrial Electrical Co., Ltd., Old Road Street Works, Offord Street, London, N.1.—Priced folder introducing "Electrocene" a non-petroleum, non-corrosive cleaning liquid for the electrical industry.

Quasi-Arc Co., Ltd., Bilston, Staffs.—Catalogue of electrodes, plant and accessories for manual and automatic arc welding.

T. B. Morley & Co., Ltd., Liberty Chambers, Jameson Street, Hull.—Illustrated folder on decorated glass pendants.

Electropower Gears, Ltd., Kingsbury Works, Kingsbury Road, London, N.W.9.—Technical folder announcing a new range of flange mounting spur gear boxes with co-axial shafts.

Cooke & Ferguson, Ltd., Victoria Street, Openshaw, Manchester, 11.—Technical folder on the type OE3 three-tank outdoor circuit breaker for use up to 750 MVA at 33 kV.

Permutit Co., Ltd., Permutit House, Gunnersbury Avenue, London, W.4.—Two technical brochures, one on base-exchange water softeners and ion exchange equipment and the other on the base-exchange water softener type DL.

G. & J. Weir, Ltd., Cathcart, Glasgow, S.4.—Technical brochure on the Weir optimum de-aerator which explains the corrosive action of dissolved oxygen in boiler feed water and shows how it can be eliminated.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 28th December.

HIVAC. No. 685,453. Class 9. Thermionic valves, cold cathode tubes, and suppressor tubes for the protection of telephone and telegraph lines from current surges.—Hivac, Ltd., Greenhill Crescent, Harrow-on-the-Hill, Middx.

COLUMBIA (design). No. 701,531. Class 9. Radio receiving sets, radiogramophones, broadcast television receivers, and parts included in Class 9 of all such goods but not including electric batteries.—Columbia Graphophone Co., Ltd., Blyth Road, Hayes, Middx.

BIRLEC (design). No. 700, 906. Class 11. Installations and apparatus for heating, refrigerating, drying and ventilating and parts (not included in other classes) of such installations and apparatus, but not including domestic refrigerators, domestic hair dryers or domestic electric fans.—Birlec, Ltd., Birlec Works, Tyburn Road, Erdington, Birmingham, 24.

Smithfield Show

Electrical Aids to Farming Efficiency and Higher Production

MECHANIZATION is being employed increasingly to secure greater efficiency and higher production on farms and a great many of the 2,500 exhibits of machinery and implements shown at the Smithfield Show and Agricultural Machinery Exhibition which was held at Earls Court, London, last week depend on electricity for their operation. Conveyors, in particular the pneumatic type, elevators, sack loaders, etc., were numerous, representing a branch of the electro farming industry in which especially great development has been made recently.

Closely allied to these were many types of seed cleaners and separators, graders, balers and food preparation equipment. New among the last-mentioned items were a development of the Christy & Norris "Major Essex" mill fitted with a suction feed and a low level grain hopper, a Fyna mill with electronic control, and the Roadless Traction "Esher" vegetable washer, which is driven by a 15 h.p. three speed motor and equipped with 1,500 jets and a 280 gall/minute pump delivery.

Side by side with the increasing use of combine harvesters has come a growing demand for grain drying plant and among equipment of all capacities shown was a mobile model of the G.E.C. drying and conditioning unit.

Milking Machine Design

Most of the developments in electrical equipment for dairy farming have been referred to in connection with the recent Dairy Show, but among the comprehensive array of milking machines, coolers, steam raisers, sterilizers, etc., we noticed a Simplex milking machine incorporating a new electric pulsator which can be controlled to give from 45 to 48 pulsations a minute, the speed never varying. Working from an independent 12 V d.c. supply it is completely safe to operate.

Refrigeration plant, represented by J. & E. Hall, Ltd., L. Sterne & Co., Ltd., Frigidaire, Ltd., the Pressed Steel Co., Ltd., British Automatic Refrigerators, Ltd., and Hussmann British Refrigeration, Ltd., was, as might be expected, principally of the type likely to be of most interest to butchers. Display counters were much in evidence and also cold rooms, the Pressed Steel Co. showing one of the latter of 150 cu ft capacity.

A mobile butcher's shop, based on a 1 ton N.C.B. battery electric vehicle chassis, attracted considerable attention especially since, being designed for inside service, it is free from purchase tax. Its freedom from fumes and dirt also makes the electric vehicle especially suitable for this class of work.

Electricity and Hygiene

The important part that the use of electricity can play in the promotion of animal health and limiting the spread of infection is the main theme of the exhibit of the British Electrical Development Association. A calf house demonstrated how hygienic conditions result from adequate lighting, ventilation and careful food preparation. Alternative methods of heating water for food-making and cleaning utensils were illustrated by the thermal storage water heater and the bucket type water heater. The speedy and humane electric dehorner was also exhibited in this section.

Of interest to the raiser of beefstock, to whom an adequate water supply is essential, was an electric water pumping system. The mechanical preparation of winter foodstuffs was catered for by electrical equipment for hay drying, root cleaning and cutting, and grain milling. The section for dairy cows was devoted to equipment used in food preparation and for preventing the spread of infection, and with steam raising, water heating, and sterilizing appliances, there could be seen low voltage electric blankets and grooming machines. Alternative methods of heating the pig farrowing and fattening pens were displayed, together with an electric foster mother. The platform type "in-sack" grain dryer and the "in-bin" ventilation

method of storing grain were shown on another section of the stand.

The British Thomson-Houston Co.'s exhibits included a selection of electric motors, control gear, heaters for steam boilers and sterilizers, magnetos, " Fabroil " silent-running non-metallic pinions and gears, and " Mazda " farm lighting equipment.

Electric fences are being used increasingly for strip grazing. The new " Warden " unit brought out by the Harvest Saver & Implement Co., Ltd., is simple to operate and by dispensing with all unnecessary " frills " and concentrating on improving the essential mechanism, is exceptionally low priced. New tent posts and insulators permit the Wolseley equipment to be moved rapidly from one part of a field to another.

Variable-Speed Rectifier Drives

Review of Applications

AT a Utilization Section meeting of the Institution of Electrical Engineers in London this week Mr. P. Bingley (Hackbridge & Hewittic Electric Co., Ltd.) presented a paper which deals with mercury arc rectifiers, mainly of the glass bulb type, for use with shunt-wound d.c. motors to provide variable-speed drives for industrial machinery. This method of speed control is rapidly finding new applications as its adaptability becomes more widely appreciated.

The rectifier motor drive is capable of supplying motors whose speed has to be varied over wide ranges against heavy torques. It cannot, however, be expected to compete economically with the simple shunt controlled drive unless local circumstances warrant a separate power unit, nor can it economically compete with the a.c. commutator motor drive where small speed ranges (say, 3:1) or wider ranges at the expense of good regulation, are required. The development of sensitive control devices and their associated circuits has enabled very accurate speed control to be obtained.

Reversals make application more difficult and increase the cost of the unit. The importance of designing the equipment after consideration of the whole drive cannot be too highly stressed. The " packaged " drive can be successful only for units of low horse-power which are produced in comparatively large quantities and are standardized, as a number of facilities must be included, all of which are not necessarily used in any one application. Furthermore, the small h.p. drives, using one or two thyratrons only, are intended merely for use with motors designed to cope with the large ripple-current values.

As a mercury-arc rectifier controlled by static electro-magnetic devices may have only about two moving parts (the cooling fan and the ignition relay) it has a definite advantage over the Ward-Leonard set, over the a.c. commutator motor, and over electronic units, which, although as static as the mercury-arc equipments, have filaments whose life is not accurately predictable, and which require heating time before being ready for operation. The efficiency of the rectifier in rectifier-motor equipments is very similar to that of normal rectifiers, so that the overall efficiency may be extremely good if the motor armature voltage is in the 500 V range, and still well comparable with other types of drive if 250 V armatures are used.

In this paper the author assumes a knowledge of rectifier and motor theory, but to assist those less familiar with rectifier practice a comprehensive bibliography has been included.

Wind Power in Ulster

FOR some time past experiments have been carried out at various sites in Northern Ireland with a view to estimating the potentialities of wind power generation. Among the points being tried out are Divis Mountain, overlooking Belfast; the Mourne Mountains, Co. Down; the Sperrin Mountains, Co. Tyrone; Knocklayfe, Co. Antrim; and Slieve Gullion, Co. Armagh. Mr. D. H. Alexander, principal of Belfast Technical College, said at Belfast on 26th November that Divis might prove to be the best site in the British Isles, being convenient to Belfast power station.

Technical Education

Requirements of the Electrical Industry

EDUCATION for the electrical industry and technical colleges were discussed in some detail last week by Dr. H. L. Haslegrave (College of Technology and Commerce, Leicester) when he presented a paper at an ordinary meeting of the Institution of Electrical Engineers in London. The object of this paper was to examine the particular part which technical educational institutions can play in the training of electrical engineers and the other personnel of the electrical industry with whom engineers are associated.

The author surveyed the facilities already available in technical institutions and said that although certain of these already had the equipment and staff capable of providing good instruction a number of improvements were necessary to give the better instruction that industry needed. Most institutions would require increased and modernized equipment, increased laboratory assistance, allowance for more specialization in teaching, reduction in the weekly teaching timetable, allowances in students' timetables for private study (with and without supervision) and adequate time for corporate and group activities. The value of social and athletic facilities in a college in the development of the abilities and characters of students was also emphasized.

Dr. Haslegrave then stressed the importance of the need for adequate provision of part-time courses for professional engineers in technical colleges and examined the particular difficulties to be overcome in achieving this. Technical colleges should not provide any courses preparing students for an engineering degree as they were better suited for a different type of course.

Industry's need for an engineering course different from the usual degree course could best be met by the organization of a sandwich course which should lead to the award to Associateship of the College of Technologists (in engineering) and could be planned on the basis of five years' duration with attendance on two days a week and a minimum entry age of 17. There was also a great need in industry for better post-graduate courses in specialized engineering subjects, which should be organized by certain technical colleges on a part-time or full-time basis.

The author also dealt with the training of personnel other than professional engineers and suggested extensions in the existing provisions for craftsmen and technicians. He went on to describe briefly three groups of courses leading to Higher National Certificates in Electrical Technology suited to technicians engaged in the manufacturing industry, in generation and supply, and in radio and television servicing. In conclusion, it was emphasized that the syllabuses for the sandwich course and the post-graduate courses for professional engineers, for the advanced course for craftsmen and for the technicians' course should be designed in intimate association with experienced persons in industry.

DISCUSSION

Mr. J. C. Jones (Regent Street Polytechnic), who opened the discussion, agreed that the technical colleges had failed to recognize the existence of the technicians in industry. In the past, technicians had been recruited from two main sources: the craft student who had made good and the professional student who had not. The main problem confronting the technical colleges was whether to provide separate courses from the beginning for professional engineers and technicians, or combined courses leading to alternative routes which students would themselves select at a stage when they were conscious of their limitations and possibilities. He was glad that the author favoured the latter solution and proposed a modified form of H.N.C. course to meet the needs of technicians, but he would have liked the composite scheme to embrace also the craftsman. Much that was appropriate to the earlier training of the craftsman could well be included in the training of the technician and professional engineer.

Both universities and technical colleges had been subjected to a spate of ill-informed

criticism on the subject of technological research. The superior attainment of the United States in this field arose not from better-trained personnel but from better facilities.

Mr. H. E. Dance (Ministry of Education) said that the tempo of the development of the schemes outlined in the paper would depend on the rate at which provision for them could be made. There were many changes which could take place in technical colleges without delay in order to improve conditions. In some colleges in towns of modest size, for example, National Certificate courses were being provided for day students, half-day and one-evening students, and evenings-only students. Before persuading industrialists to send students to more elaborate schemes, those three sets of courses might at least be reduced to two. He welcomed the suggestion that colleges should make less provision for degree courses, having seen in some places very feeble courses which were occupying space and teachers, though in others they were large and efficient. The nationalization of industries had concentrated attention on the plight of scattered apprentices for whom there was no local provision. This could be, and was, being dealt with by moving them to places where courses could be provided. For this purpose hostels were necessary.

Electricity Supply Courses

Mr. J. W. Thomas (B.E.A.) said that during the last three or four years there had been a minor revolution in the supply industry which had given rise to many problems which engineers had to tackle but with which they had been inadequately trained to deal. The technical colleges were still largely concerned with engineering techniques and did not give sufficient attention to the wider aspects of the training of engineers. The supply industry was trying to do something in that respect by providing short courses for those who were reaching positions of responsibility and had to learn how to handle aggregations of men.

Professor Willis Jackson (Imperial College) emphasized the importance of building up the corporate life of the technical colleges. During two visits to America since the war he had tried to assess in what way American engineering education was superior to our own. On scientific and technical grounds he believed it to be inferior, and large numbers of the products of the American engineering schools performed in industry a technician function, and in general on a more limited scientific and technical basis than was afforded by our National Certificate schemes, and in most cases without any systematic practical training. On the other hand, the American system provided three years in the corporate life of a university, and that was where its value lay.

Engineering Economics

Mr. E. S. Byng (Standard Telephones) urged the need for the teaching of engineering economics, a subject which had been sadly neglected in this country. The late Sir Frank Gill had said that cost consciousness without science would ruin the engineer's reputation; science without cost consciousness would ruin the engineer's employer. That was true, but many engineers who came from technical colleges and universities had no appreciation of this side of their profession.

Mr. A. Draper (College of Technology, Rugby) criticized the scheme for two days release a week on the ground that the industrial training of the student was seriously impaired. Toward the end of an apprenticeship the student should be given work involving some responsibility, but it was impossible to allocate such work to a man who was available on only three days of the week.

He described an industry-based course operating in his area, at present leading to the London external B.Sc., which had proved of value. It recruited men who had had an additional year at school beyond the general certificate of education ordinary level. Day release of one day a week, plus one or two evenings, brought them to the intermediate stage in one year, and to the Part I examination in $2\frac{1}{2}$ years, this being concurrent with $3\frac{1}{2}$ years of practical training. On passing Part I they proceeded to Part II in four terms of full-time study at college. A course of this type could be made to lead to an award by the College of Technologists.

Mr. M. W. Humphrey Davies (City and Guilds) said that they were making substantial progress in dividing existing schemes into schemes for operatives, for craftsmen and for technicians, and were considering advanced courses for the technician and

the man with a Higher National Certificate. They proposed to recognize the Ordinary National Certificate as the best method of entry for technician courses, while keeping open entry from craft and other courses.

Mr. J. Milligan (Brush Electrical Engineering Co.) advocated the type of sandwich system which allowed students to spend three, or preferably six, consecutive months at college and the remainder of the year in the factory, thus giving an opportunity for the development of corporate life and giving technical college staffs an opportunity to keep in touch with what was happening in industry. Industry required a wide variety of technicians, so there was pressing need for specialized courses.

Mr. A. M. Hodgson (Croydon Polytechnic) remarked that the demand for a Higher National Certificate in technology was understandable from the employers' point of view, but what had it to offer the student? Unless assured that it would lead to a higher salary or help them to attain corporate membership of the I.E.E., most students would prefer to work for the H.N.C. in electrical engineering.

Mr. Marples emphasized the need for technical college teachers to have works experience. Dr. A. Nemet said that the training of engineers should be such as to fit them for positions of leadership, and stressed the importance of pride in the vocation of the professional engineer; indeed, a slight touch of "professional snobbery" might do good. Mr. K. Coates pointed out that unless industry played its part and released men for adequate periods the suggested schemes could not be carried out.

The author, in the course of his reply to the discussion, confessed that he was worried by the tendency to appoint to technical colleges staff with little industrial experience.

Servicing Electrical Instruments

At a Measurements Section meeting of the Institution of Electrical Engineers in London last week there was a discussion on the servicing and maintenance of electrical instruments. The chair was taken by Mr. J. F. Coales, vice-chairman of the Section, in the absence of Mr. F. J. Lane, chairman. The discussion was to have been opened by Mr. A. J. Young and Dr. D. Taylor, but as Mr. Young was unwell Mr. W. Bamford took his place.

Mr. Bamford dealt with the servicing of electrical instruments used in large industrial undertakings. He said that these consisted of instruments for the measurement and control of power and those for the measurement of a variety of physical conditions by means of electrical detecting elements, the latter group containing electrical systems for the transmission of measurements made by non-electrical means. Dr. Taylor then spoke on the servicing of electronic instruments used in atomic energy establishments and said that experience in Ministry of Supply factories was that the real problem remained one of design.

It was generally recognized by the twelve speakers who took part in the discussion that conventional electrical instruments were comparatively trouble-free and attention was concentrated mainly on instruments which were partly or wholly electronic.

With regard to maintenance procedure, support was expressed for the use of specially skilled personnel to identify and remove faulty units, which could be promptly replaced by serviceable units and passed for repair to instrument workshops employing less skilled labour. This procedure was particularly valuable and sometimes essential under difficult conditions, e.g., in instances of radio-active contamination.

The value to maintenance personnel of clear and readily available instructions on the equipment was brought out, and one speaker showed by a slide how rearrangement of a drawing could bring out its essential character.

Several speakers gave their experience on the failure rates to be expected for various components, particularly valves, resistors and capacitors, one speaker adding small power transformers to the list of components particularly prone to failure. Varying

assessments were given of the relative importance of each category, and among valves, power rectifiers were cited as having one of the highest failure rates. Some speakers, however, gave instances of especially long and reliable operation of instruments incorporating valves.

It was not considered practicable to estimate probable lives for valves, and the importance of gradual changes in characteristics depended upon the design of the instrument. One speaker considered it uneconomic to replace valves on the basis of hours run.

In spite of difficulties with certain components, it appeared that the electronic portion of instruments in general contributed less than other (mechanical, etc.) components, to the failure of the instrument in which it was incorporated and to expense of maintenance. The time for which electronic instruments should be allowed to operate without recalibration depended upon conditions of use. Conventional electrical instruments usually retained their accuracy until rendered completely unserviceable.

Many speakers dwelt on the points of design which would minimize the need for maintenance and reduce its cost. Principal among these was a high degree of reliability. Such reliability should be obtainable under the conditions in which the instrument would require to operate, such as corrosive atmospheres, high temperatures, rough usage, etc. In some instances, instruments had to be flameproof, and this requirement restricted dissipation of heat. The desirability of robust cases and of hermetic sealing were strongly advocated. Air-cooling was a source of difficulty unless a filtered air supply was available. It was preferable to run all components well below their nominal VA rating.

Vibration and shock were some of the principal dangers to instruments in industrial plant; anti-vibration mountings must be properly designed and could not make up for lack of intrinsic robustness in the instrument. The value of plug-in units was generally recognized. Some speakers favoured the use of fully-sealed expendable units where appropriate. Accessibility was important in saving valuable process time and time of maintenance staff. Standardization of dimensions would also assist speed and convenience.

Many speakers criticized the modern tendency to " over-miniaturization," which in most industrial applications was unnecessary and increased risk of failure. It was preferable to allow more space and if necessary more VA consumption in the instrument. It was important to keep to a minimum the number of controls which could be handled by operators. Both these and pre-set controls should have means of indicating the normal setting.

Some speakers favoured the design of equipment for null indication or the use of compensating circuits, so that variation in characteristics of components or in mains voltage had negligible effect. On the other hand, in so far as such practices increased the number of components they did not necessarily improve overall reliability.

The possible applications of magnetic amplifiers and transistors were touched upon. It was pointed out that magnetic amplifiers could not entirely replace valves and used more power. A magnetic transductor could sometimes usefully replace a high-current shunt for a meter.

Television Convention

COPIES of the programme and combined registration and order form for the Convention on the British Contribution to Television to be held in London from 28th April to 3rd May, 1952, will soon be available and will be sent to all those who have asked for details of the Convention. Anyone who has not yet applied and requires details should notify the secretary of the Institution of Electrical Engineers as soon as possible; visitors from overseas will be especially welcome.

It is expected that between 60 and 80 technical papers will be presented for discussion and many of these have already been submitted. During the technical sessions which will cover all aspects of television from the programme production to the viewer, there will be interesting demonstrations of television equipment, including large screen projection television and, it is hoped, an early Baird 30-line equipment which is at present being reassembled.

During the Convention the visits of inspection, which will be open only to registered members and their ladies, will include B.B.C. television studios and the latest television transmitters, the Post Office research station, the terminal equipment of the London–Birmingham coaxial cable link and, on a limited scale, certain commercial organizations. In addition, a number of social functions are being arranged to which it is hoped registered members will bring their ladies.

Indian Fertilizer Production

Large New Factory at Sindri Bihar

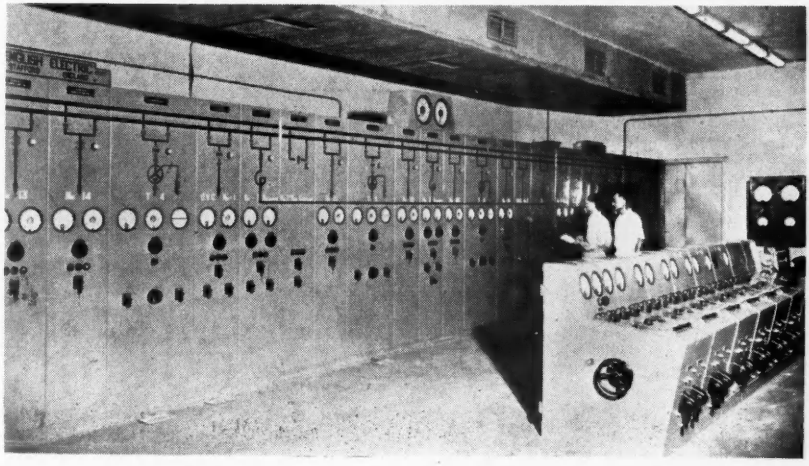
INITIATED in 1946 and just opened, a new fertilizer factory built at Sindri Bihar represents the Indian Government's most important post-war agricultural development scheme, the overall cost being approximately £20 million. The aim is to raise the country's agricultural output and improve cultivation by encouraging the use of modern methods.

The factory, for the construction of which the main British contractors are the Power Gas Corporation, of Stockton-on-Tees, is the largest of its kind in Asia; it will produce 1,000 tons of ammonium sulphate a day as well as a range of other chemical by-products in considerable quantities. Provision is made for doubling the output by the installation of additional plant, or the factory can be expanded to produce different types of products such as nitric acid for India's chemical industry in general, and ammonium nitrate or nitro-chalk for use as fertilizers.

Electric power is employed throughout the factory and a substantial amount of the generating plant, distribution equipment and electric drives has been supplied and erected by the English Electric Co., Ltd., comprising some 510 motors totalling 15,000 h.p. and 38 transformers totalling 90,750 kVA, together with switchgear. Of the motors some 391 are rated at 0·5 to 25 h.p. while the remaining 119 have ratings ranging from 30 to 275 h.p. Up to 200 h.p. they are three-phase 400 V 50 c/s machines, the larger ones operating from a three-phase 3,300 V 50 c/s supply. With the exception of 19 slip-ring induction motors on the lifts, cranes and sulphate dryers, all the rest are of the squirrel-cage induction high torque type and are arranged for direct-on starting. Most of the motors are totally enclosed, externally fan cooled and fitted with two endshield ball or roller bearings enclosed in dust proof housings. The windings on each motor are Class B insulated with glass tape and are double impregnated, including vacuum treatment.

The transformers include six of 7,000 kVA rating and having a voltage ratio of 11 kV/3·3 kV, five 3,000 kVA units with a

General view of control room in the Sindri Bihar fertilizer factory, India



similar voltage ratio and twenty-seven 1,250 kVA units having a voltage ratio of 11 kV/400 V. These include one transformer of each rating as a spare.

The generators, transformers and feeders are controlled by an English Electric 25 panel type OLG1A totally enclosed, floor mounting, horizontal-draw-out isolating, metalclad switchboard. It is arranged for double busbar service, solenoid operation, on-load busbar selection, and has a breaking capacity of 1,000 MVA at 11 kV.

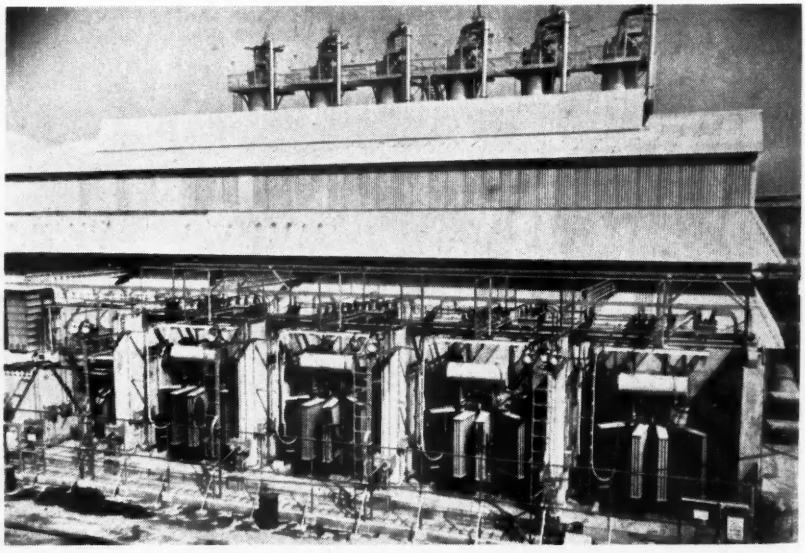
Each section is interconnected by a reactor arranged to limit the short circuit rating when all generators are operating in parallel. These reactors are accommodated in chambers immediately below the 11 kV switchgear and the connections thereto are made through air insulated conductors assembled in totally enclosed sheet steel chambers.

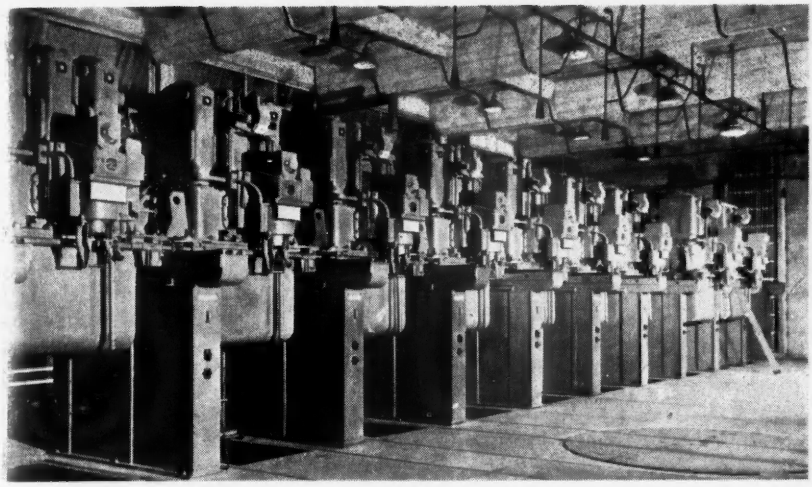
Provision for isolating the reactors is made by remote manually operated isolating switches mounted on the above chambers. The main 11 kV switchboard is controlled through a separately mounted control and relay switchboard which is of the built-up steel cubicle type arranged in corridor form. The indicating and recording instruments and mimic diagram are mounted on the front of the panels while the ancillary apparatus is mounted on the rear set of panels. Access to the rear of each set of panels is gained by a centre corridor between each set.

Control of the 11 kV side of the substation transformers is by an outdoor isolating switch of the vertical break type which is arranged for operation from ground level. Each isolating switch is interlocked with the associated oil circuit breaker on the main switchboard to ensure a correct sequence of operation. The connections between the transformer and isolating switches are made by rigid copper conductors of adequate sectional area to withstand through currents during short circuit conditions. Also accommodated on the above equipment are the current transformers required for the protection of the substation transformers.

For the control of the power station auxiliaries a 17-panel OB33 totally enclosed, floor mounted, air insulated, air-break type switchboard has been installed. This single busbar switchboard is arranged in two sections and interconnected by means of a bus section breaker. The circuit breakers are arranged for horizontal isolation, while the transformer and bus

Some of the thirty-eight transformers in the Sindri Bihar fertilizer factory





English Electric " OLG " switchgear controls the generators, transformers and feeders

section panels are solenoid operated and are provided with interlocks in order to prevent the bus section circuit breaker being closed at the same time as the transformer breaker.

Where 400 V supplies are required in the power station and power station sub-stations, suitable air-break switchgear is provided. These equipments are of the totally enclosed, floor mounting, air insulated type provided with type OB3 air-break circuit breakers arranged for single busbar service, with isolating features on both busbars and the cable side of the circuit breaker. All instruments are mounted on the front of the panels.

Installations in Temporary Bungalows

MANCHESTER Housing Committee recently asked the North Western Electricity Board to state its views as to the likely causes of fire in temporary bungalows generally, and on what appeared to be a prevailing impression that residents of these dwellings are constantly exposed to danger in consequence of defects in the electrical installations in the bungalows.

The Board replied that fires in temporary bungalows could be caused by carelessness or thoughtlessness on the part of tenants in the use of either electricity, gas or solid fuel. Reports show that the incidence of fires in prefabricated dwellings throughout the country was no higher than in permanent houses. The following measures could be taken to allay the impression of danger where it existed:—(1) annual inspection and test of all installations and appliances, (2) re-siting of socket outlets and associated wiring where condensation is found, (3) replacement of all fittings and accessories which had deteriorated, and (4) the issuing by the director of housing of an instruction card pointing out the danger of unauthorized extensions to installations, the use of 2 kW fires from 5 A socket outlets and the faulty re-wiring of fuses. Before vesting day many electricity authorities were not satisfied with the electrical installations in temporary bungalows when the temporary housing programme was first put in hand. It would be a costly business now to carry out extensive alterations to the present installations in order that the wiring should comply strictly with the current edition of the I.E.E. Regulations.

Belfast Loan

Belfast Corporation is seeking the sanction of the Ministry of Commerce to a loan of £1,025,000 to meet the cost of the second stage of the Electricity Department's scheme for distribution system extensions.

RECENT INTRODUCTIONS

NOTES ON NEW ELECTRICAL AND ALLIED PRODUCTS

Orbital Sander

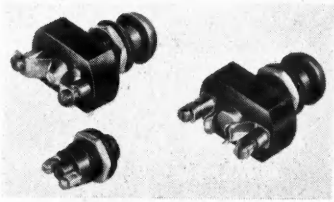
A PORTABLE orbital sander produced by S. N. BRIDGES & CO., LTD., Bridges Place, Parsons Green Lane, London, S.W.6, gives a hand polishing movement for the rapid finishing of wood, composition, metal and plastic. On wood it sands with, against and across the grain to produce an exceptionally fine finish. The "Sorbo" rubber pad, which measures 7¼in by 4¼in and describes 4,000 movements per minute, conforms to level, convex or concave surfaces, and "quick action" clips automatically hold the paper to the right sanding tension. The net weight is 10 lb and the machine is driven by a ¾ h.p. universal motor. Complete with three assorted sand paper sheets, the price is £32.

Another new Bridges product is a portable electric router for grooving, moulding, routing and rabbeting in wood and metal alloys. With one collet and one ¼in diam flute cutter, the tool costs £29 10s.

Press-Button Switches

Among the latest "Rafi" products to be made available by LONDEX, LTD., Anerley Works, 207, Anerley Road, London, S.E.20, are two press-button switches. The heavy duty pattern is rated at 4 A on 250 V a.c. and can be fixed to panels up to ½in thick by means of a ⅝in hole. It is available with change-over, normally-open or normally-closed contacts. For motor control purposes the normally-open type can be supplied with a green knob and the normally-closed type with a red knob.

The miniature switch is rated at 0·7 A on 250 V a.c. and can be fitted to a ⅜in thick panel by means of a ⅝in hole. It is available with either normally-open or normally-closed contacts and can have a black, green or red knob.



Londex press-button switches

Hot-cup for Aircraft

A 1½-pint hot-cup, designed primarily to supplement other facilities by permitting the rapid service of beverages to customers' individual orders, is an addition to the appliances for aircraft catering made by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. An important feature is the ease with which the 500 W 28 V d.c. element can be replaced if renewal is necessary.

Left: **G.E.C. hot-cup for aircraft**

Right: **Bridges orbital sander**

ELECTRICITY SUPPLY

Scottish Housing Development

Progress of Erne Scheme

THE South West Scotland Electricity Board has approved a scheme, estimated to cost £96,000, for supplying electricity to more than 2,200 new houses which are being erected by Glasgow Corporation at Barlanark estate, Springboig. Approval has also been given by the Board to a scheme, estimated to cost over £28,000, for supplying the first 400 new houses which are being erected by Lanarkshire County Council as part of a large housing development at Cairns site, Cambuslang, near Glasgow.

Transmission Line Over Tyne

The British Electricity Authority has applied to the Minister of Transport for permission to construct a transmission line across the Tyne at Newburn.

Supply to Devon Market Town

As a climax to a year which has seen the provision of a mains electricity supply in the East Devon market town of Colyton (population about 2,000), an electrical exhibition with fuel efficiency as its main theme was held in the Town Hall. Electricity first came to Colyton in 1921 when Mr. Fred Hann, owner of a local saw mill, introduced a 25 V waterwheel plant to provide a 5 kW supply to his mill. Later he installed a further plant to supply a number of people. Eventually the South Western Electricity Board took over the system and more than 2,000 yd of l.v. and h.v. underground cable were laid and nearly 8,000 yd of overhead line and six substations erected. The Board adapted the appliances of 400 consumers to the a.c. supply, though not obliged to do so, the former undertaking being a non-statutory one. The number of consumers at Colyton is now about 500.

Councillor D. F. Baker, J.P., chairman of Colyton Parish Council, switching on the lighting to inaugurate the local electrical exhibition. On the extreme right is Mrs. F. Forrest, chairman of the Regional Peak Load Economy Committee

Installations Delayed

Newcastle-on-Tyne City Council's plans for installing electricity in pre-war houses not already supplied are being delayed owing to the limited resources available. Work on 773 houses is in hand, but the City Council has been informed by the North Eastern Electricity Board that no further installations can be carried out at present.

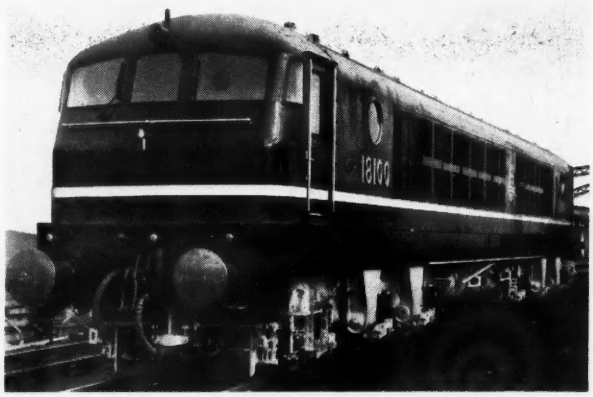
Indian Electricity Undertakings

A list of thirty-five electricity supply undertakings in India which are predominantly owned or managed by foreign interests is published in *Indian Trade and Industry* (16th November). By far the biggest undertaking is that of the Calcutta Electric Supply Corporation, Ltd., which is shown to have had a generating capacity of 434,750 kW at 31st December, 1950, and an output of 85½ million kWh in 1949. Next in order are the undertaking of the

Ahmedabad Electricity Co., Ltd. (82,500 kW; 211 million kWh); and the Gourepore Electric Supply Co., Ltd. (53,350 kW; 68 million kWh). All the others are of 18,000 kW or less.

Erne Plant Commissioned

The half-way mark of the partial development of the Erne hydro-electric scheme was reached on 27th November when Mr. J. B. S. Lawlor, A.M.I.E.E., station superintendent, brought into commission the first of two 22,500 kW generating sets at Cathaleen's Falls Station, Ballyshannon, Co. Donegal. Nearer the Northern Ireland border at Cliff, four miles upstream from Ballyshannon, a 10,000 kW generating set has been in operation for more than a year and another of similar size is expected to be working by the end of 1954. This will complete the partial development of the scheme. The estimated annual production is 200 million kWh, but the full output is dependent on water storage development works on Lough Erne in Northern Ireland. These works, costing £750,000, are being carried out under an agreement between the Northern Ireland Ministry of Finance and the E.S.B.



Manufactured by the Metropolitan-Vickers Electrical Co., Ltd., this 3,000 h.p. gas turbine locomotive, the first to be built in this country, will be shortly delivered to the Western Region of British Railways

Plan to Harness Ulster Rivers

The Northern Ireland Government is expected shortly to make known the details of a scheme to harness the rivers Bann and Mourne. Such a scheme, it has been calculated, would produce about 20,000 kW. Both rivers possess exceptionally fine salmon fisheries, commercial and sporting, and on the Lower Bann there is the most valuable eel fishery in Europe. The chief production points are at Caronroe on the Lower Bann, and at Sion Mills on the Mourne, at the centre of a linen industry.

Belgian Railway Electrification

The Belgian State Railways have started work on the electrification of the Brussels–Ostend line.

North Wales Power Bill

Merioneth County Council is entering formal opposition against the British Electricity Authority's North Wales Hydro-Electric Power Bill. A special committee appointed by the Council to explore the implications of the Bill considers that there should be provision ensuring that the B.E.A. will guarantee to supply all local authorities affected by the schemes with water which may be required for domestic and industrial purposes, and also to supply electricity to the areas concerned within a specified number of years as well as expediting supplies to the county as a whole.

Board Renews Claim

The S.E. Scotland Electricity Board has made a further appeal to the Minister of Fuel and Power for the return of a proportion of the general reserve funds held on vesting day by local authority electricity undertakings in its Area. It has asked that representations already made on this subject should be reconsidered. The Board is convinced that " on merits " there is a conclusive case for action on the lines which it has suggested to the Minister.

Cost of Supplying Estates

At a meeting of the S.E. Scotland Electricity Consultative Council it was intimated that the Area Board was considering falling into line with other Boards as regards charges made to local authorities for the provision of electricity supplies for housing. The Board, it was stated, had incurred considerable capital expenditure in supplying new housing estates, and the present yearly revenue of between £3 and £4 per house was insufficient to meet all the costs.

Profit from Illuminations

Southend-on-Sea Illuminations Committee reports that the Corporation will benefit by an estimated £11,700 as a result of this year's illuminations. To the net surplus of £8,250, after charging £487 for additional policing, cleansing and street lighting, there is added £950 from increased rents of kiosks and £2,500 from rates on properties in the sea front area.

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

First Electric Corporation of South Africa, Ltd.—The annual meeting is being held to-day (Friday). In his statement issued with the report and accounts Mr. L. Jacobson (chairman) says that the net profit for the year ended 30th June last is £165,150, as compared with £77,159 for the previous year. The directors have decided to strengthen the reserves rather than pay an ordinary dividend, and £88,775 has been transferred to general reserve while a reserve has been created for future development at the three works, £35,000 being set aside for this purpose. This leaves a balance to be carried forward of £60,182 (against £100,218 brought in). In view of the satisfactory trading results during the current financial year to date, an interim ordinary dividend of 5 per cent in respect of the year to 30th June, 1952, has been declared. After referring to the satisfactory progress of the subsidiary companies, Knights Works, African Malleable Foundries, Ltd., and L. H. Marthinusen, Ltd., the chairman says that the turnover of the three factories now exceeds £2,000,000 per annum. A large proportion of this turnover is in equipment manufactured to the designs of Associated Electrical Industries, Ltd., of Great Britain, and the sale of such equipment is handled by Metropolitan-Vickers, South Africa (Pty.), Ltd., and British Thomson-Houston Co. South Africa (Pty.), Ltd.

Dewhurst & Partner, Ltd., report a trading profit, together with investment and other income, of £117,309 for the year ended 30th September last, as compared with £86,806 for 1949-50. After deducting taxation of £60,000 and other charges, the net profit is £40,764 (against £36,738). From this the following deductions are made :—Bonus issue expenses, £1,097; transferred to capital account re bonus issue £95,059; interim dividend of 10 per cent, £3,150. It is proposed to pay a final dividend of 12½ per cent, making 22½ per cent for the year. The final dividend is paid on capital of £180,000 (against 25 per cent on £60,000). The balance carried forward is £77,816 (against £148,170 brought in).

The Jerusalem Electric & Public Service Corporation, Ltd., reports a balance for the year to 31st March last of £I.108,387, after deducting administration expenses, as compared with £22,622 for the previous year. Central amortization fund receives £21,243, plant renewals and depreciation £80,000, and provident fund £6,500. The balance carried forward is £3,876 (against £3,232 brought in).

The London Electrical & General Trust, Ltd., has declared an interim dividend of 2½ per cent (against 2 per cent).

New Companies

J. J. Sampson & Son, Ltd.—Registered in Dublin 19th November. Capital £15,000. Manufacturers of and dealers in electrical and mechanical equipment and hardware of all kinds, etc. Directors : J. J. Sampson, 82, Howth Road, Clontarf, Dublin, and B. J. Sampson, 11, Glebe Estate, Howth Road, Dublin.

Electrical Agencies, Ltd.—Registered in Dublin 21st November. Capital £5,000. Agents, importers, exporters and general merchants, including mechanical and electrical engineers, etc. Subscribers : H. S. Danaher, 20, Grove Road, Rathmines, Dublin, and B. Corr, 9, Leeson Park Avenue, Dublin.

Charles A. Klemm, Ltd.—Registered 6th December. Capital £5,000. Electrical and general engineers, etc. Directors : C. A. Klemm and Elvira M. Klemm. Registered office : 153, Moorgate, E.C.2.

Rental Collections, Ltd.—Registered 23rd November. Capital £900. Hirers and renters of radio, electrical and television apparatus and equipment, etc. Directors : A. J. Escott, Edith E. Escott, Dora K. Cordell, A. E. Birch and Eileen M. Allen. Regd. office : 109, Maybank Road, South Woodford, E.18.

Harold Simpson, Ltd.—Registered 6th November. Capital £3,000. Manufacturers and repairers of and dealers in wireless and television sets, etc. H. Simpson is permanent managing director. Regd. office : 140/142, St. James Street, Burnley.

Browning & Voss, Ltd.—Registered 28th November. Capital £100. Mechanical, electrical, electronic, wireless, television and general engineers, etc. Directors : W. H. Grimmer, J. M. Lloyd Jones and R. A. Voss. Regd. office : 50, Bow Lane, Cheapside, E.C.4.

Richard Hardy (Electrical Engineers), Ltd.—Registered 28th November. Capital £5,000. To acquire the business of an electrical engineer and contractor now carried on by R. Hardy at Prince Royd, Birchencliffe, Huddersfield, and at 24, Spring Street, Huddersfield. First directors : R. Hardy

and others to be appointed. Regd. office: 24, Spring Street, Huddersfield.

Alytron Radio & Television Co., Ltd.—Registered 3rd December. Capital £100. Manufacturers of and dealers in radio and television sets, etc. Directors: C. R. Pearce and P. E. Seppings. Solicitors: Ernest G. Scott & Co., 31/2, Broad Street Avenue, E.C.2.

Increase of Capital

Pritchett & Gold and E.P.S. Co., Ltd.—Increased by £200,000, in £1 ordinary shares, beyond the registered capital of £200,000. On 16th May, 1951, the National Accumulator Co., Ltd., held practically all the issued shares.

Liquidations

Elexcel, Ltd.—In voluntary liquidation, members' winding-up. Particulars of claims by 1st February to Hill, Dickinson & Co., 10, Water Street, Liverpool, 2, solicitors for Messrs. W. P. Scowcroft and G. D. Christie, the liquidators. (See advertisement pages.)

T. & H. Electrical Service, Ltd.—Winding up voluntarily. Liquidator, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2.

Hart Accumulator Co., Ltd.—Winding up voluntarily as a members' voluntary winding-up. Liquidator, Mr. H. C. Gill, 10, Norfolk Street, Manchester, 2.

National Accumulator Co., Ltd.—Winding up voluntarily as a members' voluntary winding up. Liquidator, Mr. H. C. Gill, 10, Norfolk Street, Manchester, 2.

Bankruptcies

W. D. Newell, 35, Duke Street, Padstow, radio and electrical engineer.—Public examination 3rd January at the Town Hall, Truro.

F. Taylor, 4, Mercer Court and 46, Fenwick Street, Liverpool, electrical and general contractor.—Last day for receiving proofs for dividend 18th December. Trustee, Mr. P. S. Booth, 5, Rumford Place, Liverpool, 3.

Australian Notes

From Our Own Correspondent

A SELECT Committee appointed by the Tasmanian Parliament to report on the State's power supply says that there is no single reason for the present shortage. Several causes include an unprecedented demand for power; changed economic conditions with consumers using more appliances; increased costs and shortage of other sources of heat and power; extensions to new homes, businesses and industries; and contract commitments to bulk users. Slowness during war years to develop Clarke Dam and Butler's Gorge power station have been major factors in preventing the output capacity from reaching a stage at which it might have coped with the situation. Future policy is laid down as a two-fold one: the utmost economy with demand restricted to the most essential usages, and the pressing ahead of water power resources.

The Tasmanian Government intends to submit a Bill to Parliament for the expenditure of £16½ million for new hydro-electric works. Two major power schemes are involved, one at Wayatinah and the other at Lake Echo. The former will cost £11 million. Completion of the works is scheduled for 1958. The State's power output will then be raised to 2,730 million kWh annually.

A leading Australian financial journal states that the supply of power is critical for the development of both primary and secondary industry. Engineers have assured Australia that she has ample power supplies for a much larger population than the country is carrying at present, but their situation is not ideal. Reserves of coal will last many generations and potential hydro-electric resources are great, particularly if New Guinea is included. However, the known resources of black coal are mainly in the eastern coastal areas, the brown coal is in the south-east, and the water power is also concentrated mainly around the eastern areas, including Tasmania. The existing flow of power is being fully utilized, even to the point of being rationed. Schemes are therefore in hand to expand electrical generating capacity, the main one being the Snowy River project, which would provide a total of 668,000 kW. If the proposals can be carried out according to plan, capacity will be increased three-fold.

The Sydney County Council recently raised the price of electricity to its 315,000 consumers—to householders by 10·5 per cent; to commercial users by 22·2 per cent; and to industrial users by 24·2 per cent.

It is reported that erection of the new Kembla (N.S.W.) factory of British Australian Power Cables Pty., Ltd., is proceeding satisfactorily. Requisite machinery is available for installation, together with the raw materials necessary to commence manufacture. Paper insulated metal sheathed power cables up to and including 33 kV will be made and the range extended upward as required.

STOCKS and SHARES

STOCK Exchange markets continue to be depressed and nervous. The need for investment to reorient its previous sense of what income should be required from various classes of securities, presses heavily upon business enterprise. Holders of shares are wont to argue that prices have fallen so considerably that, unless compulsion requires, sales must be avoided, or at all events postponed. On the other hand, people with money who in the ordinary way would be wanting to invest it, are restrained from doing so by the uncertainties which prevail.

Electricity Stocks

Together with most of the other long-dated Government securities, the 3½ per cent British Electricity stock, redeemable 1976–79, passed another landmark this week when, at a price of 90, the "redemption" yield rose a little above 4 per cent. This yield is, of course, calculated after taking into account the capital profit (something over 12 points in this case) on the eventual repayment of the loan at 100. The current, or "interest" yield, which excludes that factor, is about 3·9 per cent. On the two 3 per cent British Electricity stocks, quoted now at about 85½ for the issue redeemable 1968–73, and 84½ for the 1974–77 stock, the current yields are around 3½ per cent, and the "redemption" yields very close to the 4 per cent mark. However hardly it may fall in most directions, this latest slump in gilt-edged prices is at least making matters easier for trustees to invest at a reasonable rate of interest, while assuring something more than the mere maintenance of the capital in the long run.

Falls Continue

The list of falls in prices of electrical issues is again a heavy one this week. Some three dozen quotations in our monthly list have been marked down, the falls ranging from 1s to 5s, the latter being the loss shown by Lancashire Dynamo at 42s 6d. Johnson & Phillips, 55s, are 3s 6d lower. Siemens are 3s 9d down at 38s 9d, and Westinghouse Brake at 55s. Declines of a florin or half-a-crown are shown by Hoover, 28s 9d, English Electric, 57s 6d, Walsall Conduits, 58s 9d, Crabtree Electrical, 35s 6d, British Insulated Callender's, 30s 6d London Electric Wire, 42s 6d, Falk Stadelmann, 41s 3d, Metal Industries, 39s and Murex, 52s are others that have given way.

English Electric New Shares

New ordinary shares offered at 55s to English Electric shareholders near the beginning of this month opened at a premium of 4s 9d, which has since fallen off to 1s 6d under the influences referred to in the above note. The old shares were about 65s just before the announcement of the issue, and are now 57s 6d ex rights. This means that they offer the buyer a return of appreciably more than 5 per cent on his money, assuming the maintenance of the dividend at 15 per cent. When the rate was raised to that figure last February, the company said that both output and earnings from normal business were amply sufficient to support it, in normal trading conditions, in the foreseeable future. In making this month's issue (with which was combined a private placing of £3 million debenture stock) the directors estimated that group profits for 1951 would be higher than last year's. Work in connection with rearmament has been superimposed on the expansion of normal business, in which current turnover is calculated to be double that of 1948.

New Issues

Heavy weather continues to embarrass the launching of new capital issues, and the market effects of these operations remain one of the main points of interest in the investment situation. Difficulties arise principally from the weak and shifting basis of the gilt-edged market. There has to be a considerable interval between the fixing of the terms on which stock is to be issued and the actual offer itself. Meanwhile, the sort of plunge of which market prices have shown themselves capable in the past month or so, can leave an issue more or less stranded at an unrealistic price; and the failure of one issue makes matters increasingly difficult for the next. In the case of offers of ordinary shares to existing shareholders by way of "rights," prices are having to be fixed well below ruling quotations in order to cover contingencies and to ensure subscription. The inevitable selling of "rights" on these occasions exerts a particularly depressing market influence at a time when new investment is anything but enterprising.

Dated and Undated

The three British Electricity stocks fall into the "medium-to-long-dated" category which ordinarily appeals most to the average investor. Repayment dates in all cases are, it is true, a little too distant to act effectively at this stage as a stabilizing factor in the prices, but the certainty of their eventual return to 100, serves to exercise a pull which is by no means negligible; it provides the capital safeguards lacking in irredeemable issues, or in stocks, such as 3½ per cent War Loan, which are repayable only at the option of the Treasury. Yields in these last categories are correspondingly high (over 4¼ per cent now in the case of War Loan) but many people are prepared to accept a smaller return in consideration for a fixed repayment date. Holders of stock on those terms have been spared the worst consequences of this year's gilt-edged slump.

NEW BOOKS

A Guide to Plastics. By C. A. Redfarn. Pp. 112; figs. 19; illus. 13; index. Published for *British Plastics* by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 7s 6d.

The author of this book has set out to explain exactly what " plastics " are and how various products are made from these materials. He describes the basic raw materials in some detail, explains how manufactured materials for industrial use are obtained and then shows how these materials are fabricated by various moulding methods into finished goods of many kinds.

A feature of the book is a series of coloured charts which show all the stages of manufacture from raw materials to finished goods in each of the main categories of plastics. The book will be of great value not only to students but also to those already engaged in the industry and all others who wish to learn more about the commercial development of this important branch of chemistry.—R.P.

The Oxide-Coated Cathode. Vol. II. By G. Herrmann and S. Wagener. Pp. 311; figs. 152; bibliography and index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 42s.

The second volume of this book discusses the theory of thermionic emission from metals and semi-conductors. It thus combines the whole of the contents of Volume I of the German edition with the more theoretical part of the second volume. The material has been subjected to a very thorough revision, and the literature up to the end of 1950 has been reviewed.

The first third of the book, about 100 pages, consists of a lucid review of the relevant phenomena in pure metals, approached from the aspect of statistical mechanics. Next, fifty pages are devoted to the theory of ionic solids and to a general discussion of semi-conductors. The remaining half of the book deals in detail with the oxide cathode and attempts to build up a consistent theoretical picture of its operation. Detailed comparison is made with experimental material wherever possible. The book is always clear, and presents a very good account of the existing state of knowledge on the oxide cathode.

Since 1945 oxide cathodes have been the subject of intensive research which has led one school of workers to question whether the cathode really behaves as a simple excess semi-conductor in the operating temperature range or not. Although references to this work are given, the authors do not sufficiently stress the divergence of opinion, and one is left with the impression that semi-conductor theory satisfactorily explains all the phenomena. This is not yet proven, and may not be true.

The authors are to be congratulated on having produced an accurate and readable synopsis of the subject at a time when very active developments are taking place. It will be greatly valued by all workers in the field.—A.H.B.

Encyclopedia on Cathode-Ray Oscilloscopes and Their Uses. By J. F. Rider and S. D. Uslan. Pp. 982; figs.; bibliography and index. Chapman & Hall, Ltd. Price 75s in U.K.

This monumental American volume is undoubtedly the most comprehensive work on cathode-ray oscilloscopes and their uses so far produced as not only is the theory thoroughly explained but practical everyday uses in virtually all fields are examined. It is written in such a way as to be useful to both the beginner and the specialist. There is a wealth of informative circuits, diagrams and illustrations and a comprehensive collection of references to other literature on the subject, making the book a valuable addition to the library of the engineer.—R.P.

Books Received

Principles of Alternating Currents. By W. Sluckin. Pp. 320; figs. 165; index. Cleaver-Hume Press, Ltd., 42a, South Audley Street, London, W.1. Price 10s 6d.

Electric Lighting. By C. E. Gimson. Pp. 224; figs. 79; index. Cleaver-Hume Press, Ltd. Price 9s 6d.

Conduction of Electricity Through Gases. By K. G. Emeléus. Pp. 99; figs. 37; bibliography and index. Methuen & Co., Ltd., 36, Essex Street, London, W.C.2. Price 5s 6d.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s each) will be obtainable after 23rd January from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1944

7264. Philips Lamps, Ltd.—Electronic discharge devices. 19th April, 1944. (665341.)

1946

27224. Compagnie Générale de Telegraphie sans Fil.—Time indicating and measuring apparatus for use in radar and other radio echo systems. 10th September, 1946. (665442.)

1947

64. Siemens Electric Lamps & Supplies, Ltd., and Millington, J. N.—Electric discharge lamps. 1st January, 1948. Cognate application, 1571, 17th January, 1947. (665342.)

8863. Contraves Akt.-Ges.—Electric follow-up systems. 1st April, 1947. (665541.)

28328. Standard Telephones & Cables, Ltd.—Receiving and transmitting device for printing telegraphic signals. 23rd October, 1947. (665343.)

33062. Minerva Mouldings, Ltd., and Marston, G. S.—Insulated nuts. 15th December, 1948. (665544.)

1948

1856. Sperry Gyroscope Co., Inc.—Radio-beam navigation systems. 21st January, 1948. (665445.)

5981. Director of the Office of Technical Services, Department of Commerce.—Magnetrons. 27th February, 1948. (665450.)

6352. Chilowsky, C.—Piezo-electric plastic material and method of making same. 29th February, 1948. (665451.)

6353. Chilowsky, C.—Method and apparatus for making artificial piezo-electric elements. 29th February, 1948. (665452.)

11672. British Thomson-Houston Co., Ltd., Rolfe, E., and Smith, D.—Electric motor control systems for constant tension centre driven wind up drivers. 31st March, 1949. (665348.)

14108. Brush Development Co.—Hydrostatically sensitive piezo-electric transducer. 25th May, 1948. (665351.)

14497. British Thomson-Houston Co., Ltd.—Electric discharge devices. 28th May, 1948. (665550.)

18398. Brush Development Co.—Magnetic recording and reproducing. 8th July, 1948. (665461.)

20395. Crespi, G., and Fransesco, L. D. B.—Process for forming refractory linings in electric arc furnaces and refractory blocks for the same. 30th July, 1948. Convention date not granted. (665551.)

22387. Stevens, A. H. (Armour Research Foundation of Illinois Institute of Technology).—Method of making magnetic material. 25th August, 1948. Convention date not granted. (665554.)

23329. Percival, W. S.—Asymmetric side band radio signalling. 23rd August, 1949. (665267.)

25967. Braten, J. L., and Hoel, H.—Electric protective systems. 5th October, 1948. (665465.)

27721 & 27933/4. English Electric Co., Ltd., and Smart, D. L.—Electric discharge devices. 21st October, 1949. (665467/9.)

30086. Standard Telephones & Cables, Ltd.—Multi-cavity magnetrons. 19th November, 1948. (665470.)

30248. Standard Telephones & Cables, Ltd., Roberton, J. S. P., and Pocock, L. C.—Telephone set circuits. 18th November, 1949. (665274.)

30400. Igranic Electric Co., Ltd.—Electric welding. 23rd November, 1948. (665360.)

30659. Metropolitan-Vickers Electrical Co., Ltd., and Belsey, F. H.—Saturable core reactance devices. 24th November, 1949. (665277.)

31236. Philips Electrical, Ltd.—Circuit arrangements for deriving voltages exhibiting a relative phase difference from a control voltage of varying frequency. 2nd December, 1948. (665364.)

33562. Cassman, H.—Electron-discharge devices such as television transmission tubes. 20th December, 1949. (665279.)

1949

510. Philips Electrical, Ltd.—Frequency-changing circuits for decimetre and centimetre waves. 7th January, 1949. (665285.)

1721. Waygood-Otis, Ltd.—Control for electric circuit. 21st January, 1949. Addition to 610407. (665294.)

3696. British Thomson-Houston Co., Ltd.—Multi-position electric switches for use with heating units. 10th February, 1949. (665370.)

5405. Metropolitan-Vickers Electrical Co., Ltd.—Commutating dynamo-electric machines. 17th February, 1950. Addition to 657105. (665301.)

6285. Hirst Electronic Development, Ltd., Hirst, S., and Collins, F.—Electric welding. 27th February, 1950. (665303.)

6608. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for the measurement and control of the angular displacement of an electric motor. 14th March, 1950. (665380.)

6704. New Day Electrical Accessories, Ltd.—Connection with electric socket contact elements. 24th February, 1950. (665381.)

7637. British Thomson-Houston Co., Ltd.—Frequency-modulation receiving systems. 21st March, 1949. (665306.)

9507. English Electric Co., Ltd.—Double break switch-gear of the enclosed type. 24th March, 1950. (665385.)

10197. Radio Corporation of America.—Stabilization of microwave oscillators. 14th April, 1949. (665390.)

10407. Compagnie Industrielle des Telephones.—Stopping circuits of rotary switches having a marking multiple common to several marking devices. 20th April, 1949. (665391.)

11802. Rheostatic Co., Ltd.—Motor-operated regulating valve. 3rd May, 1950. (665482.)

11983. Automatic Telephone & Electric Co., Ltd.—Electrical signalling systems. 11th March, 1950. (665483.)

12728. Metropolitan-Vickers Co., Ltd.—Ward-Leonard systems. 2nd May, 1950. (665319.)

13676. Stevens, A. H. (Thomas & Betts Co.)—Electrical cable connecting assemblies. 23rd May, 1949. (665493.)

17251. Compagnie G nérale de Telegraphie sans Fil.—Velocity-modulated valves of the reflex type. 29th June, 1949. (665505.)

17727. Jones, D. G.—Electric heating jackets more especially for vessels containing liquids. 28th June, 1950. (665509.)

17903. Soc. Anon. de Telecommunications.—Demodulators for frequency-modulated waves. 6th July, 1949. (665403.)

19993. Western Electric Co., Inc.—Electrical switching systems. 29th July, 1949. (665519.)

20559. Igranic Electric Co., Ltd.—Unidirectional pulse producing electric circuits. 8th August, 1949. (665406.)

22127. Preparation Industrielle des Combustibles.—Electrically operated level indicating arrangements. 25th August, 1949. (665409.)

24188. Bendix Aviation Corporation.—Electric recording apparatus. 20th September, 1949. (665530.)

24595. Polyderoff, W. J.—Tunable very high-frequency circuits. 24th September, 1949. (665532.)

24835. Lucas, Ltd., J.—Electric circuit-condition indicators. 20th September, 1950. (665568.)

24836. Lucas, Ltd., J.—Thermally operable electric switch. 20th July, 1950. (665569.)

25382. General Electric Co., Ltd., and Bispham, G. E.—Coaxial conductor electrical transmission lines. 18th September, 1950. (665534.)

25669/2. Brooke, W., and Baldwin, H. T.—Remote control and protection of electric motors, cables or other apparatus. 26th October, 1949. (665570/3.)

25798. Standard Telephones & Cables, Ltd., Richards, E. A., and Pease, W. E.—Electric regulators. 7th October, 1949. (665335.)

26389. British Insulated Callender's Cables, Ltd., Keefe, E. J., and Lorch, H. R.—Manufacture of insulated electric conductors. 13th October, 1950. (665418.)

26931. Du Pont De Nemours & Co., E. I.—Blue fluorescent agents. 10th October, 1949. (665415.)

27182/3. Donovan Electrical Co., Ltd., and Fair, J. W.—Electromagnetic contactors. 23rd October, 1950 (665536/7.)

27463. Brooke, W., and Baldwin, H. T.—Earth leakage protective systems. 26th October, 1949. (665576.)

29413. Philips Electrical, Ltd.—Means for controlling the speed of alternators. 17th November, 1949. (665336.)

29606. Graciarena, E., and Edery, F.—Automatic protective device for an electric apparatus. 18th November, 1949. (665338.)

29731. British Thomson-Houston Co., Ltd.—Phase-angle responsive circuits. 21st November, 1949. (665584.)

29838. Chatelet, H. G. J., and Michellet, H.—Electromagnetic change-speed mechanism particularly for automotive vehicles. 22nd November, 1949. (665425.)

32230. Sperry Corporation.—Impedance matching devices for hybrid tee wave-guide junctions. 15th December, 1949. (665434.)

33460. Nickel Anodes & Non-Ferrous Castings, Ltd., and Beach, J. S.—Electroplating anodes. 5th September 1950. (665599.)

NEXT WEEK'S EVENTS

Monday, 17th December

BIRMINGHAM.—The University, 6.15 p.m. Birmingham Electric Club. "The Modern Oil Engine and its Applications," by R. W. S. Mitchell.

BOURNEMOUTH.—Grand Hotel, Firvale Road, 8.15 p.m. A.S.E.E. Bournemouth Branch. "Electric Resistance Heating," by T. F. Stanley.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio Section. Informal lecture on "What Practical Benefits can Communication Engineers expect from the Modern Information Theory?", by E. C. Cherry.

NEWCASTLE-ON-TYNE.—King's College, 6.15 p.m. I.E.E. North Eastern Radio and Measurements Group. Lecture summarizing the papers read at the Conference on "Electrical Instrument Design," by G. E. Moore.

Tuesday, 18th December

BIRMINGHAM.—Town Hall, 6 p.m. I.E.E. South Midland Centre. Faraday Lecture. "Sound Recording—Home, Professional, Industrial and Scientific Applications," by Dr. G. F. Dutton.

LONDON.—Lighting Service Bureau, 2, Savoy Hill, W.C.2, 6.30 p.m. Association of Supervising Electrical Engineers. "The Engineer in the Welfare State," by R. F. Mathieson.

At the Institution of Mechanical Engineers, Storey's Gate, S.W.1, 5.30 p.m. Institute of Fuel. "Gasification by the Moving-Burden Technique," by J. W. R. Rayner.

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Measurements Group. "Some Special Characteristics of Soft Magnetic Materials Used in Instrument Manufacture," by Dr. G. A. V. Sowter.

Wednesday, 19th December

BRIGHTON.—Technical College, 6.30 p.m. I.E.E. Southern Centre. "Electricity in a Chemical Works," by W. A. Gallon.

LEICESTER.—De Montford Hall, 7.15 p.m. I.E.E. East Midland Centre. Faraday Lecture. "Sound Recording—Home, Professional, Industrial and Scientific Applications," by Dr. G. F. Dutton.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Inhibited Transformer Oil," by W. R. Stoker and C. N. Thompson. "The Stability of Oil in Transformers," by P. W. L. Gossling and L. H. Welch.

MANCHESTER.—Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. "Chairman's Night."

Thursday, 20th December

CHELTENHAM.—Cadena Café, High Street, 6.15 p.m. I.E.S. Gloucester & Cheltenham Centre. "Light as an Aid to Crime Detection," by C. H. Edlin.

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. Discussion on "Electricity Tariffs and Rationing," opened by Lt.-Col. Edgeworth.

LUTON.—George Hotel, 8 p.m. A.S.E.E. Luton Branch. "Maintenance of Factory Equipment," by A. Carpenter.

Nigeria's Growing Imports

RECENT statistics of Nigeria's import trade in electrical goods show an increase in value to about three times that of five years ago. The principal items during the first half of 1951 were: machinery, £258,000; telegraph and telephone apparatus, £70,000; complete radio sets, £33,000; radio parts and accessories, £10,000; and unspecified electrical apparatus, £522,000. The last group included batteries (£121,000), and refrigerators, £56,000. The future holds promise of increased trade as the development schemes included in the ten-year plan for which a loan of £6,800,000 has been raised cover electric power supply, telecommunications and the building of dwellings and schools.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section, the date of the issue is given in parentheses.

Cambridge.—City Council. Electrical installations at Queen Edith's Way Primary Schools. (See this issue.)

Greece.—ATHENS.—28th January. Ministry of Communications and Telecommunications Reconstruction Procurement Committee. Complete trunk telephone exchange installation for the city of Athens. (C.R.E. (I.B.) 77532/51. Ten/3339.)*

Luton.—1st January. Corporation. Electrical installations in houses and flats and supply of seventy-two 20 gall water heaters. (See this issue.)

New Zealand.—AUCKLAND.—14th January. Auckland Electric Power Board. Supply of twenty 300 kVA 3-phase transformers. (C.R.E. (I.B.) 77161/51. Ten/3327.)*

Pakistan. — KARACHI. — 21st December. Department of Supply and Development. Supply of twelve 3.3 kV 75 MVA oil circuit breakers, three 3,300/110 V potential transformers, twelve current transformers, and seven oil immersed power transformers. (C.R.E. (I.B.) 77081/51. Ten/3323.)*

15th January. High Commissioner for Pakistan. Supply of electric cable. (See this issue.)

Salford.—5th January. Corporation. Street lighting equipment for the year ending 31st March, 1953. (See this issue.)

South Africa.—CAPE TOWN.—20th February. Electricity Department. Street lighting equipment. (C.R.E. (I.B.) 76856/51. Ten./3311.)*

Southern Rhodesia. — SALISBURY. — 14th February. Southern Rhodesian Government. Supply of 88 kV transformers and auxiliary equipment. (C.R.E. (I.B.) 76915/51. Ten/3321.)* 20th February. Electricity Supply Commission. Two 100/120,000 lb/hr water tube boiler units for Umniati "B" power station. 27th February. Two 50/60,000 lb/hr water tube boiler units for Shabani No. 2 power station. (C.R.E. (I.B.) 76916/51. Ten/3334.)*

Tangier.—30th January. Department of Water and Electricity. Construction of a network of public lighting by fluorescent lamps. (C.R.E. (I.B.) 77053/51. Ten/3338.)*

Uruguay. — MONTEVIDEO. — 14th January. Usinas Electricas y Telefonos del Estado. Supply of four to six 20/28,000 kg/hr steam generators. (C.R.E. (I.B.) 75489/51. Ten/3331.)*

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, S.W.1 (Victoria 9040).

ORDERS PLACED

Jarrow-on-Tyne.—Town Council. Electrical installations in houses on the No. 15 housing estate (£2,259).—Messrs. McTomney, South Shields.

Manchester.—Highways Committee. Supply of 15,000 yd of cable in connection with street lighting conversions.—Thomas & Doyle (Drighlington.)

Northumberland.—Education Committee. Electrical installation at county library headquarters at Morpeth (£1,824).—A. Haggerty, Ashington.

Ryton-on-Tyne.—U.D.C. Electrical installations in 56 houses on the Garden House estate, Ryton.—Storey & Crowe.

Swindon.—Sewage Works and Water Works Committee. Two dual fuel engine-driven alternator sets and other ancillary equipment for Rodbourne Sewage Works (£12,217).—English Electric Co., Ltd.

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Barrow-in-Furness.—Houses (118), flats and garages, Tummerhill site; borough surveyor.

Bedford.—Houses (220), Eastcotts Road estate; borough surveyor.

Bristol.—Completion of Council House, College Green (£45,000); J. N. Meredith, city architect, Eagle House, Colston Avenue.

Bromley.—Separate contracts for 108 houses and 78 houses, Hayes Place estate; borough surveyor, Municipal Offices.

Buckinghamshire.—School building programme for 1952-53 includes Bletchley County Secondary School (£134,640) and Old Bradwell County Infants' School (£18,480); county architect, Aylesbury.

Bury St. Edmunds.—Reconstruction work (after fire), West Suffolk General Hospital (£88,794), for East Anglian Regional Hospital Board; H. G. Frost, builder, Westgate Road, Bury St. Edmunds.

Chadwell Heath (Essex).—Works extensions; Motor Gear & Engineering Co., Ltd., Essex Works, High Road.

Cheltenham.—New factory; Davis, Wynn & Andrews, Ltd., Wellington Road.

Coventry.—Three-storey building for administrative offices, assembly hall, gymnasium, hostel, canteen, etc., for police headquarters (about £400,000); D. E. E. Gibson, city architect, 1a, Warwick Row.

Crawley.—Secondary school at New Town (£118,985); James Longley & Co., Ltd., builders, Joinery Works.

Dagenham.—Works and offices, Hainault estate; Daniel T. Jackson, Ltd., Roding Lane North, Woodford Bridge.

Derby.—Factory at Osmaston Park Trading Estate; borough architect.

Ennerdale.—Houses (50), Lowca, for R.D.C.; John Laing & Sons, Ltd., Dalston Road, Carlisle.

Epsom.—Extensions at District Hospital; S. C. Vincent, electrical and heating consultant, 76, Wimpole Street, W.1.

Hartlepool.—Additions to factory for J. B. Pillin, Ltd., engineers, Hartlepools Trading Estate.

Ilford.—Drill hall and offices; Essex Territorial & Auxiliary Forces' Association, Market Road, Chelmsford.

Kidderminster.—Factory, Worcester Road; H. I. J. Engineering Co., Ltd., Cherry Orchard.

London.—BLOOMSBURY.—Five-storey hostel, Tavistock Square; British Medical Association, B.M.A. House, W.C.1.

DEPTFORD.—Block of flats, St. Donats Road, S.E.14; H. V. Ashley & Winton Newman, architects, 3, Verulam Buildings, Gray's Inn, W.C.1.

Lowestoft.—Reconditioning of St. Luke's Hospital (£80,000); J. Stinton Jones & Partners, electrical and heating consultants, 21, Gloucester Place, W.1.

Luton.—Factory extensions; Adamant Engineering Co., Ltd., Dallow Road.

Macclesfield.—Proposed factory on Hurdsfield estate; C. H. Johnson, Ltd., wire, etc., manufacturers, Adswood Road, Stockport.

Manchester.—New university building near Mayfield Station (£500,000); city architect.

Middlesbrough.—Middle Beck No. 1 County Secondary School; Turner & Ing, quantity surveyors, 2, Garden Street, Darlington.

Milnrow (Lancs).—Extensions to factory, Albert Mill, for Tomlinsons (Rochdale), Ltd., Oldham Road, Rochdale; A. Boothroyd, architect, Yorkshire Street, Rochdale.

Newcastle-on-Tyne.—Workshops for the Rutherford College of Technology (£29,000); A. Anderson, Ltd., builders, Stanmore Road.

Old people's hostel at Kenton; city architect, 18, Cloth Market.

Maternity and child welfare centre, Blakelaw estate (£13,730); Anglo-Scottish Construction Co., Ltd., builders, Gosforth.

Primary school, Broadwood Road (£150,000); C. S. Errington, 46, Grainger Street.

Mineral water factory, White Street, for Novo Bottlers, Ltd.; L. J. Wood, 51, Link Avenue, Monkseaton.

Newcastle-under-Lyme.—Pithead baths, canteen, etc., Silverdale Colliery; Wood, Goldstraw & Yorath, architects, Gordon Chambers, Hanley.

Nottingham.—Occupational centre at Bulwell (£17,668); J. Everitt & Son, Watnall, Notts.

Oswestry.—Police divisional headquarters (£38,000); A. G. Chant, county architect, Column House, London Road, Shrewsbury.

Oxford.—Dwellings (82), on site of Freeland Hotel; Hinkins & Frewin, Ltd., builders, Canal Street, Oxford.

Paignton.—Children's home; H. V. de Courcy Hague, architect, 97, Heavitree Road, Exeter.

Penrith.—Houses (28); Holmeriggs Avenue, for U.D.C.; John Laing & Son, Ltd., Dalston Road, Carlisle.

Plymouth.—Office block, St. Andrew's Cross; Royal Insurance Co., Ltd., North John Street, Liverpool.

Reading.—Technical college; Griggs & Son, Ltd., builders, Victoria Street, London, S.W.1.

Redhill.—Out-patients' department at County Hospital (£117,000); R. Phillips, architect, 9, Bentinck Street, London, W.1.

Romford.—Houses (64), Fuller's Farm estate; A. S. Wilson & Partners, 8, Prince's Street, Storey's Gate, Westminster, S.W.1.

Girls' secondary school, Harold Hill estate; Richard Sheppard & Partners, architects, 16, Bedford Place, W.C.1.

Scunthorpe.—Primary school, Grange Lane, Ashby (£40,000), 1952-53 programme; county architect, Lincoln.

Shrewsbury.—Ambulance depot, Nearwell, Abbey Foregate; J. Bromley & Sons, Church Stretton, Salop.

South Shields.—Extensions to transport depot (£45,000); borough engineer.

Old people's hostel, Marsden Road; borough engineer.

Stoke-on-Trent.—Maternity and child welfare centre on site at Fenton (£13,415); W. A. Bott, borough surveyor, Town Hall.

Sunderland.—Community centre, Ford estate; borough architect, Town Hall.

Surbiton.—Factory additions; Combustions, Ltd., mechanical stokers, etc., Cox Lane.

Swansea.—Rebuilding shop premises, 229/230, High Street; Morrisons Associated Companies, Ltd., 76, Mortimer Street, W.1.

Warwickshire.—New fire station and six firemen's houses at Stratford-on-Avon (£36,200); county architect, Warwick.

Wellingborough.—Houses (48) for R.D.C.; H. W. Sheffield, surveyor.

West Bromwich.—New works proposed by McArthur & Co., Ltd., ironfounders, etc., Paradise Street.

Whitchurch (Salop).—C.C. First stage of new infants' school; county architect, Shrewsbury.

Wolverhampton.—Erection of Rake Gate Infants' School; F. & E. V. Linford, Ltd., Park Road, Cannock.

York.—Houses (26), Appleton-le-Moors, Gillamoor, Great Edstone and Kirbymoorside; city engineer, Guildhall.